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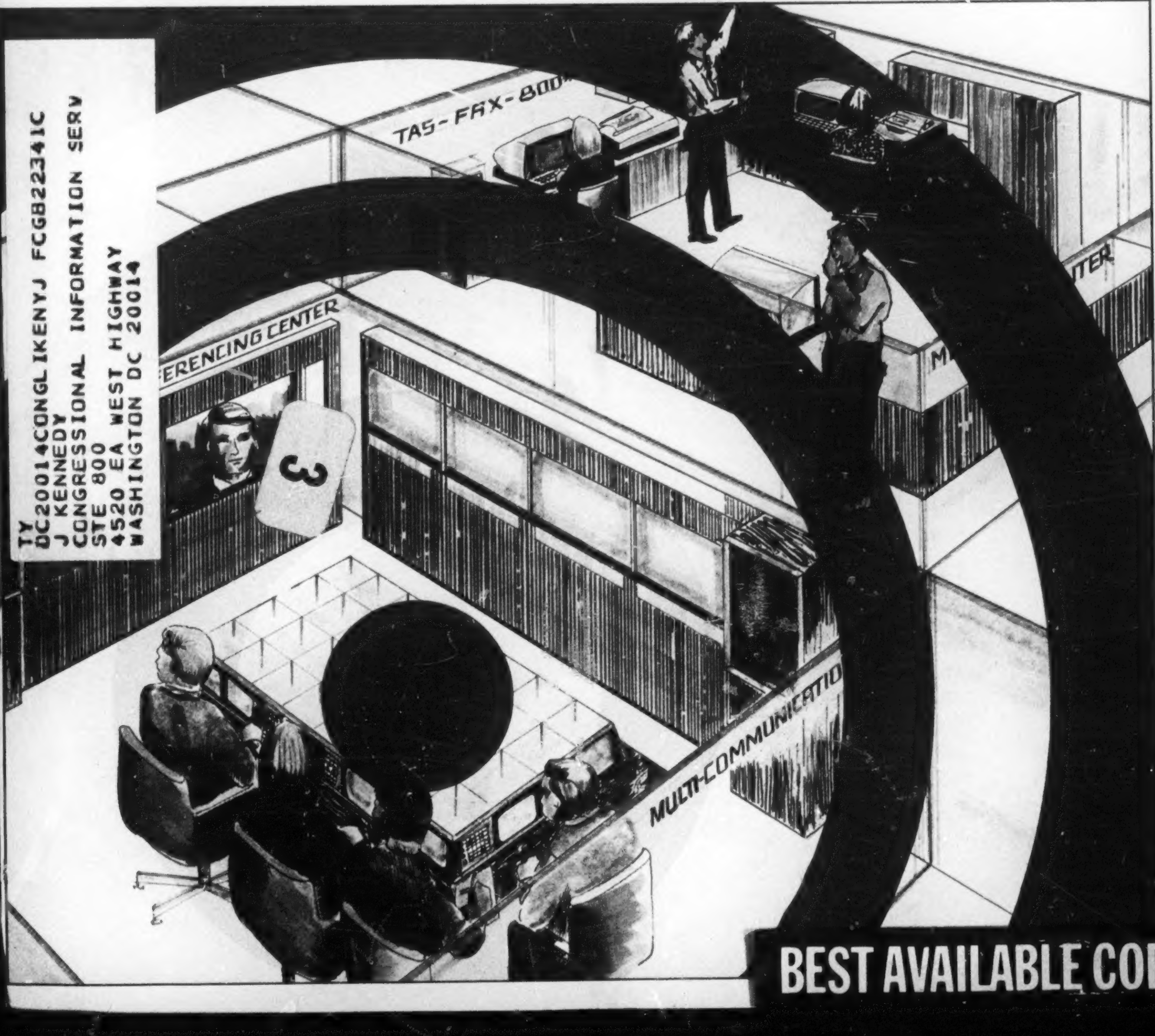

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Mergers and moderate growth cloud the TAS market forecast

Analysis of past trends among telephone answering services indicates their number will fall in the future due to market forces

TELEPHONE answering services (TAS) answer incoming calls with a live operator, who interfaces personally with the caller and takes messages. The answering services rely heavily on live operators in selling the professional image they provide clients, as opposed to the image provided by a telephone answering machine (TAM). Answering machines are the primary competition for TASs, and may be leased from the telephone company or purchased outright from outside manufacturers. The market is currently apportioned among these three services (Figure 1).

The entire telephone answering industry has been growing steadily. Growth for the TAS industry in particular is shown in Table 1.

These figures indicate an interesting trend. In the early and middle 1970s, the number of subscribers rose steadily, yet the increase in the number of TASs did not keep up with the increase in subscribers. Thus, each existing TAS grew, from an average of 150 subscribers in 1972 to an average of 189 subscribers in 1977. Receipts per TAS rose accordingly.

However, due to either response to increased demand or recognition of a good thing, thousands of new TASs were started between 1977 and 1980. With this increase in competition, the average size of a TAS dropped back to 155 subscribers. Any TAS that had expanded during the previous years may now be experiencing an erosion of its subscriber base, and may be hard pressed to maintain its profit margin. This is a major spur to the consolidation and merger activity currently taking place in the industry.

Market and technological changes

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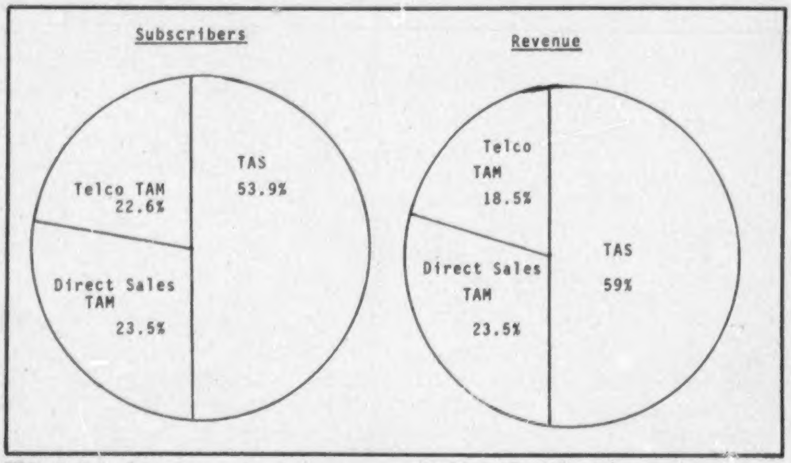

FIG. 1 *Telephone answering industry: current share of total market.*

Table 1

Growth of TAS Industry

	Number of subscribers	Number of TASs	Receipts ($1000)	Subscribers per TAS	Receipts per TAS
1972	720,000	4804	273,173	150	56,864
1977	1,078,413	5700	493,500	189	86 579
(Est.) 1980	1,425,000	9167	640,000	155	69,816

This article is taken from a summary of a report on recent research conducted by Frost & Sullivan, Inc., a market research firm in New York. The report is entitled, "Telephone Answering and Radio Paging Services and Associated Equipment Markets," Copyright 1981. This has been printed here with permission.

are having a strong affect on the TAS industry. Previously, TASs were restricted by interconnect regulations to rental of TAS equipment from the local telephone company. Although that system had its disadvantages, chief among them being total reliance on telephone company rates and service, it had an important advantage for many—start-up costs were very low. Thus, many small TASs were started in a spare room or basement, serving a small number of local, often rural, clients.

Recently, however, purchase of equipment from either the telephone company or an outside manufacturer has been approved. This alone would not be sufficient to change the industry, but in combination with technological changes, it has had a major impact.

Technological advances have made the traditional cordboard obsolete. Few manufacturers are still providing them. Boards currently in service in the vast majority of TASs are old, and require more frequent and costly repairs. Telephone companies, in order to recoup these repair costs, are raising tariffs for the cordboards each year; they are becoming too expensive for many TASs. Through the purchase options, the larger, well-funded TASs are purchasing automated systems, which allow them to fix their costs for long periods of time, and offer stable pricing and superior service to subscribers. Many smaller TASs, which lack the capital or the desire to purchase their own systems, are unable to compete in terms of price. This would have little impact on the small, rural or suburban TAS without the advent of call forwarding. Originally, the TAS had to be located close to its subscribers, because each had to run a telephone line from its establishment to the TAS. It had to pay monthly mileage charges to the telephone company for that line. Call forwarding allows several subscribers to share a line, thus making it economically feasible for a large TAS in a city to serve clients in the suburbs or beyond.

The combination of these factors makes it difficult for the smaller TASs to compete effectively. Thus, recent years have seen an increase in merger and consolidation activity within the industry. In fact, there is likely to be a gradual leveling off and eventually a slight reduction in the total number of TASs nationwide as a result of mergers (Table 2).

As might be expected, there will be changes in the manufacturers' shares of the market due to these changes. The cordboard and key system manufacturers that currently have 95% of the market have not become involved in production of the new automated systems. Thus, as the decade progresses, their share of the market will decrease significantly. Of the companies in the automated end, the primary three currently are Amtelco, Candela and Telescan. However, during the latter half of the decade, they should see more competition from firms whose products are not yet widely distributed.

However, the fact that the telephone companies' manufacturing arms have not entered the market is not an indication that the telcos themselves have withdrawn from the market. Indeed, due to the cost of purchase and the unavailability of credit, it is predicted that, by the end of the decade, approximately 60% of all automated TASs will be renting systems rather than purchasing them. The local telephone company will continue to be the primary avenue for rental of TAS equipment. In fact, telephone company revenues through rental of TAS equipment (primarily automated) are expected to reach $197 million by 1990 (Table 3).

Table 3 also indicates that sales of automated systems will peak in 1986, and start to decline markedly toward the end of the decade. This is attributable to the predicted culmination of most of the merger and consolidation activity by that time. In order to remain competitive, most TASs will have to avail themselves of the automated equipment by that time, or they will have been merged with a larger, more competitive, automated firm.

It should be noted that the market for these systems is limited, and the recommendation is for planned production over the coming decade, as well as diversification into supporting product lines and services, preferably beginning now. Potential exists in the predicted merger of TAS with other telecommunication services (radio common carriers being the major natural extension) into a communications processing center for small businesses. □

Table 2

TAS industry forecast

	Number of subscribers	Number of TASs	Receipts per ($1000)	Subscribers per TAS	Receipts
1977	1,078,413	5700	493,500	189	86,579
1980	1,425,000	9167	640,000	155	69,816
1983	1,725,000	9600	770,000	180	80,208
1987	2,185,000	9500	950,000	230	100,000
1990	2,500,000	9275	1,105,000	270	119,137

Table 3

Automated sales forecast

	Number of systems sold	($1000) Dollar value of sales*	Of systems sold, number sold to telco for rental	($1000) Dollar value of telco sales*	($1000) Total telco revenues (all equipment)*
1981	152	23,385	0	0	124,000
1984	455	75,996	240	29,886	147,000
1987	759	136,096	600	82,566	173,000
1990	305	58,057	200	29,970	197,000

*Present dollars

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IBM to become Intel's largest single shareholder, p.13

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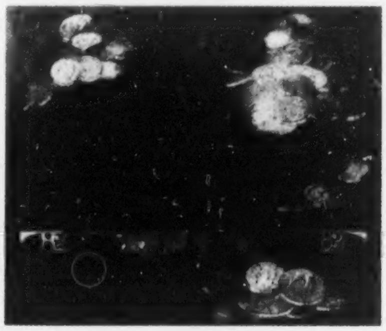
Telecom spending nears $29 billion for new, composite telecom industry in '83

Spending in the telecom industry continues to climb, but the identities of the spenders are changing rapidly and will continue to change

DEL MYERS, EDITOR, and CZATDANA INAN, MARKET RESEARCH DIRECTOR

U.S. TELECOMMUNICATIONS equipment spending in 1983 will reach an estimated level of $28.9 billion, $7.0 billion more than the combined 1982 spending of Bell and the Independent telephone companies.

Before betting on an unprecedented telecommunications boom, however, the composition of these figures deserves close examination. The figures do not correlate exactly with TELEPHONY's last annual review and forecast (TELEPHONY, Jan. 11, 1982, p. 25). Also, this report covers some new telecommunications entities but not all of them.



Cover art by Leon Danilovics

A lot of money hangs in the balance when telecom establishments draw up their annual budgets. One thing is for certain: expenditures on telecommunications will continue to grow because telecommunications services are more important than ever before.

This review and forecast includes the principal successors to the monopoly telephone industry and an in-depth profile of the Fortune 1000 industrial companies and 300 service organizations recently surveyed by TELEPHONY.

The following sources supplied the data from which we have extrapolated a reasonable, composite picture

Table 1 Independent and Bell Construction Expenditures

	Independent Telephone Companies (millions of dollars)**			Bell Telephone Companies (millions of dollars)***			Combined Independent & Bell Telephone Companies (millions of dollars)		
	Const Spending	Increase (Decrease) vs Previous Year	% Increase (Decrease)	Const Spending	Increase (Decrease) vs Previous Year	% Increase (Decrease)	Const Spending	Increase (Decrease) vs Previous Year	% Increase (Decrease)
1961	$566	$—	$—	$2,759	$—	—	$3,325	$—	—
1964	780	—	—	3,566	—	—	4,346	—	—
1967	1,254	—	—	4,359	—	—	5,613	—	—
1970	1,665	—	—	7,314	—	—	8,979	—	—
1973	2,325	—	—	9,516	—	—	11,841	—	—
1976	2,481	59	2.4	10,044	519	5.5	12,525	578	4.9
1977	2,797	316	12.7	11,793	1,749	17.4	14,590	2,065	16.5
1978	3,471	674	24.1	13,951	2,158	18.3	17,422	2,832	19.4
1979	4,205	734	21.1	16,050	2,099	15.0	20,255	2,833	16.3
1980	4,544	339	8.1	17,505	1,455	9.1	22,049	1,794	8.9
1981	4,852	308	6.8	18,019	514	2.9	22,871	822	3.7
1982	4,825	(27)	(0.6)	17,030	(989)	(5.5)	21,855	(1016)	(4.4)
1983*	5,115	290	6.0	16,800	(230)	(1.4)	21,915	60	0.003

*Estimated
**Source: USITA
***Source: AT&T (Bell Telephone Companies include AT&T, its principal telephone subsidiaries, and Bell affiliates, Southern New England Telephone Co and Cincinnati Bell, whose common stocks are minority-owned by AT&T)

of the new telecommunications industry: the top 23 Independent telcos will spend an estimated $5.1 billion in 1983; American Telephone & Telegraph Co. (AT&T) will spend an estimated $16.8 billion in 1983; interconnect companies and their affiliates will account for an estimated $5.5 billion in 1983; and the top 6 specialized common carriers (SCCs) will spend an estimated $1.5 billion in 1983. Thus, the total estimated spending in 1983 for the entire industry will be $28.9 billion.

Naturally, a review and forecast based on the new telecommunication reality may not be as satisfying as were the monopoly-based ones. But the monopoly clock is running out in many areas and, as more competitive clocks begin ticking, reliable data becomes more elusive.

Even the significance of traditional data is beginning to change; for example, the number of telephones owned by Bell and the Independents. Once a leading indicator of company health and progress, these data already show the shift toward customer ownership: In 1982, the Independents owned 344,000 fewer phones and the estimated decrease in 1983 is 2.5 million.

Even more drastic changes in telephone ownership are occurring in the Bell System with the transfer of

Continued on page 30

Table 2 Independent Telephone Company Statistics

Number of Telephones (000 omitted)

	Year-End Total	Change
1976	28,209	—
1977	29,675	1,466
1978	31,549	1,874
1979	33,226	1,677
1980	34,665	1,439
1981	35,341	676
1982	34,997*	(344)
Change 1976-1981	7,132 = 25% of year-end '76	
1983	32,493*	(2,504)

Investment in Gross Plant ($000,000 omitted)

	Year-End Total	Change
1976	$23,000	—
1977	25,130	2,130
1978	27,788	2,658
1979	31,644	3,856
1980	35,300	3,656
1981	38,298	2,998
1982	42,163*	3,865
Change 1976-1981	$15,298 = 67% of year-end '76	
1983	45,936*	3,773

Number of Independent Telephone Exchanges

	Year-End Total	Change
1976	11,040	—
1977	11,045	5
1978	11,053	8
1979	11,050	(3)
1980	11,040	(10)
1981	11,086	46
1982	11,090*	4
Change 1976-1981	46 = 0.004 of year-end '76	
1983	11,095*	5

Total Operating Revenues ($000,000 omitted)

	Year-End Total	Change
1976	$ 6,300	—
1977	7,115	815
1978	8,085	970
1979	9,240	1,155
1980	10,475	1,235
1981	12,206	1,731
1982	14,136*	1,930
Change 1976-1981	$5,906 = 94% of year-end '76	
1983	15,718*	1,582

Number of Independent Telephone Companies

	Year-End Total	Change
1976	1,590	—
1977	1,556	(34)
1978	1,527	(29)
1979	1,488	(39)
1980	1,483	(5)
1981	1,459	(24)
1982	1,435*	(24)
Change 1976-1981	(131) = (8%) of year-end '76	
1983	1,415*	(20)

Employes

	Year-End Total	Change
1976	160,000	—
1977	167,000	7,000
1978	179,000	12,000
1979	190,000	11,000
1980	194,000	4,000
1981	197,200	3,200
1982	195,700*	(1,500)
Change 1976-1981	37,200 = 23% of year-end '76	
1983	194,600*	(1,100)

*Estimated Source: USITA

Table 3 Independent Telephone Company Composite Plant Statistics ($000,000 Omitted)

Buildings

	Year-End Total	Increase
1976	$1,439	—
1977	1,523	$ 84
1978	1,644	121
1979	1,826	182
1980	2,024	198
1981	2,143	119

Change 1976-1981
$704 = 49% of year-end '76

Aerial Cable

	Year-End Total	Increase
1976	$2,360	—
1977	2,516	$156
1978	2,698	182
1979	2,979	281
1980	3,269	290
1981	3,493	224

Change 1976-1981
$1,133 = 48% of year-end '76

Central Office Equipment

	Year-End Total	Increase
1976	$ 7,543	—
1977	8,170	$ 627
1978	8,964	794
1979	10,128	1,164
1980	11,420	1,292
1981	12,648	1,228

Change 1976-1981
$5,105 = 68% of year-end '76

Underground Cable

	Year-End Total	Increase
1976	$ 910	—
1977	976	$ 66
1978	1,082	106
1979	1,245	163
1980	1,408	163
1981	1,594	186

Change 1976-1981
$684 = 75% of year-end '76

Station Apparatus

	Year-End Total	Increase
1976	$2,058	—
1977	2,275	$217
1978	2,536	261
1979	2,919	383
1980	3,102	183
1981	3,220	118

Change 1976-1981
$1,162 = 56% of year-end '76

Buried Cable (Plowed In)

	Year-End Total	Increase
1976	$2,851	—
1977	3,219	$368
1978	3,655	436
1979	4,166	511
1980	4,857	691
1981	5,401	544

Change 1976-1981
$2,550 = 89% of year-end '76

Large Private Branch Exchanges

	Year-End Total	Increase
1976	$599	—
1977	660	$ 61
1978	726	66
1979	853	97
1980	928	75
1981	959	31

Change 1976-1981
$360 = 60% of year-end '76

Underground Conduit

	Year-End Total	Increase
1976	$567	—
1977	607	$ 40
1978	665	58
1979	766	101
1980	885	119
1981	947	62

Change 1976-1981
$380 = 67% of year-end '76

Vehicles, Other Work Equipment

	Year-End Total	Increase
1976	$404	—
1977	460	$56
1978	551	91
1979	641	90
1980	717	76
1981	804	87

Change 1976-1981
$400 = 99% of year-end '76

PhoneCenter Stores to American Bell Inc. and the intensification of retail marketing at outlets such as Sears (TELEPHONY, Nov. 8, 1982, p. 11). In fact, when current inventories are exhausted, the Bell operating companies will be out of the new customer premise equipment business, at least for a time.

In such unsettled times, no forecast can have the degree of certainty and completeness it once had.

But this unique, composite snapshot of a dynamic industry in transition is of vital importance to all entities. It shows more clearly than ever how the telecommunications revenue, cost and investment streams are branching, narrowing, widening, deepening and, sometimes, disappearing.

The telephone industry

The 1983 combined construction spending of Bell and the Independent telephone companies is estimated at $21.9 billion, a 0.003% increase over 1982 spending. Of this amount, the Independent share is $5.1 billion; Bell's, $16.8 billion which is 1.4% less than the amount spent in 1982 (Table 1).

> **'. . . when current inventories are exhausted, the Bell operating companies will be out of the new customer premise equipment business. . .'**

The combined total of $21.9 billion spent in 1982 represents a decrease of $1 billion (4.4%) from 1981 spending, with Bell showing the major decrease—$989 million (5.5%).

In 1982, Independents had planned to spend $5.4 billion but actually spent $4.8 billion, slightly less than they spent in 1981. Consequently, the projected increase to a 1983 spending level of $5.1 billion, adjusted for inflation, represents a real decrease rather than the stated increase of 6%.

The Independent growth rates (Table 2) also show significant decreases: the number of telephones owned, although still positive, declined from 28 to 19%. The growth rate in gross plant investment slid from 70 to 52%; operating revenues, from 89 to 72%. The number of employes will fall from a 1981 high of 197,200 to approximately 194,600 in 1983. And the number of Independents slowly continues to decrease at the rate of 6 to 8% annually.

Table 4 Bell System Composite Plant Statistics
($000,000 omitted)
(source AT&T)

Buildings

	Year-End Total	Increase
1976	$8,950	—
1977	9,553	$ 603
1978	10,080	527
1979	10,680	600
1980	12,117	1,437
1981	12,834	717

Change 1976-1981
$3,884 = 43% of year-end '76

Large Private Branch Exchanges

	Year-End Total	Increase
1976	$3,230	—
1977	3,256	$ 26
1978	3,300	44
1979	3,385	85
1980	3,495	110
1981	3,597	102

Change 1976-1981
$367 = 11% of year-end '76

Underground Cable

	Year-End Total	Increase
1976	$6,262	—
1977	6,760	$498
1978	7,393	633
1979	8,189	796
1980	9,146	957
1981	9,863	717

Change 1976-1981
$3,601 = 58% of year-end '76

Aerial Cable

	Year-End Total	Increase
1976	$7,126	—
1977	7,659	$533
1978	8,258	599
1979	8,950	692
1980	9,798	848
1981	10,341	543

Change 1976-1981
$3,215 = 45% of year-end '76

Station Apparatus

	Year-End Total	Increase
1976	$7,238	—
1977	8,039	$801
1978	9,026	987
1979	9,889	863
1980	10,875	986
1981	11,708	833

Change 1976-1981
$4,470 = 62% of year-end '76

Buried Cable (Plowed In)

	Year-End Total	Increase
1976	$7,357	—
1977	8,283	$ 926
1978	9,421	1,138
1979	10,735	1,314
1980	12,078	1,343
1981	13,337	1,259

Change 1976-1981
$5,980 = 81% of year-end '76

Central Office Equipment

	Year-End Total	Increase
1976	$35,351	—
1977	37,714	$2,363
1978	40,403	2,689
1979	43,140	2,737
1980	46,468	3,328
1981	49,157	2,689

Change 1976-1981
$13,806 = 39% of year-end '76

Vehicles & Other Work Equipment

	Year-End Total	Increase
1976	$1,225	—
1977	1,365	$140
1978	1,548	183
1979	1,852	304
1980	2,101	249
1981	2,316	215

Change 1976-1981
$1,091 = 89% of year-end '76

Underground Conduit

	Year-End Total	Increase
1976	$4,266	—
1977	4,646	$ 380
1978	5,189	543
1979	5,873	684
1980	6,617	744
1981	7,103	486

Change 1976-1981
$2,837 = 67% of year-end '76

Total Station Equipment

	Year-End Total	Increase
1976	$18,117	—
1977	19,835	$1,718
1978	21,974	2,139
1979	24,372	2,398
1980	27,117	2,745
1981	29,610	2,493

Change 1976-1981
$11,493 = 63% of year-end '76

Comparable Bell System statistics were unavailable for this report. Comparable statistics will not be available until the company's massive restructuring plan is approved by the U.S. District Court overseeing the AT&T-Dept. of Justice settlement. Complicating the already complex situation is the separate AT&T subsidiary, American Bell Inc., formed in compliance with the Computer II decision of the Federal Communications Commission (FCC).

AT&T revenues, as of Nov. 30, 1982, were $64.6 billion, up 13% over the Nov. 30, 1981 figure of $57.3 billion. In spite of this revenue increase, net income for the latest 3 month period (September-November 1982) decreased by 3.4%. This first quarterly decrease in 7 years, according to AT&T Chairman Charles Brown, resulted from the recession.

The composite of Independent and Bell plant statistics (Tables 3 and 4) illustrates the massive investment in telecommunications plant already in place—not estimated—at the end of 1981. For the period 1976-81, the Independents' average investment growth was 65%; Bell's, 56%.

The top 23 Independents partici-

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Table 5 Construction Spending of Major Independents, plus other '82 Year-End Estimated Figures (dollar figures are in millions)

Company	No. of Access Lines	No. of Telephones	Plant Investment	Operating Revenues	Construction Spending Actual 1981	Construction Spending Actual 1982	Construction Spending Estimated 1983	Construction Spending Estimated 1984
GTE	9,600,000	16,000,000	$19,400	$ 6,600	$2,300.0	$2,300.0	$2,400.0	$2,700.0
United[a]	2,946,962	4,489,069	5,408	1,832	588.0	550.0	570.0	633.0
Continental	2,098,791	2,951,900	3,840	1,326	390.8	432.5	495.8	523.1
Centel	1,178,000	1,567,500	1,986	694	198.9	187.4	188.6	187.2
Mid-Continent	700,000	1,145,000	1,234	333	103.1	124.0	140.0	144.0
	16,523,753	26,153,469	31,869	10,785	3,580.0	3,593.9	3,794.4	4,187.3
% Total Ind	—	74.7%	75.6%	76.3%	73.8%	74.5%	74.2%	—
Puerto Rico Tel	—	697,447	1,054	297	113.1	90.0	108.0	111.0
Rochester Tel	428,984	528,313	575	223	53.6	43.9	46.0	50.8
Lincoln Tel	195,000	341,200	359	117	37.0	36.0	32.1	29.1
Century Tel	197,000	301,000	327	135	28.6	30.0	38.0	40.0
Telephone & Data	155,350	261,000	274	70	24.5	33.0	27.5	19.1
Commonwealth	135,400	247,944	206	56	12.3	14.0	17.0	19.5
Pacific Telecom[b]	114,100	219,000	785	362	81.6	191.9	104.1	95.3
Allied Tel	138,000	211,000	251	67	23.7	23.0	25.0	32.8
Anchorage Tel[c]	96,300	204,980	216	73	22.6	24.9	15.7	22.9
Illinois Consolidated	73,500	120,000	128	49	12.6	21.4	18.5	19.0
North State	67,700	118,000	71	27	6.6	7.0	8.0	8.0
Citizens Utilities	74,300	114,579	238	71	35.2	30.5	29.9	29.7
Concord Tel	61,500	100,000	63	20	4.2	3.0	3.2	5.0
CP National	55,200	92,800	164	55	20.7	19.6	16.2	21.0
North-West Tel	—	76,300	81	24	8.7	10.2	6.7	7.8
North Pittsburgh	—	61,400	54	18	4.6	5.2	6.0	6.0
Universal Tel	—	59,700	65	18	11.2	6.5	4.8	2.1
Denver & Ephrata	—	55,500	37	11	2.5	2.6	3.1	3.8

[a] Total Telephones as of Sept. 30, 1982
[b] Formerly Telephone Utilities. Figures include Alascom (long distance carrier), acquired June 1982
[c] Access lines do not include a 15,000-line switch to be in service Feb. 1, 1983

pating in this survey (Table 5) account for approximately 87% of the 1982 gross plant investment of the entire Independent industry (Table 2) and 88% of the operating revenues. The top 5 Independents account for approximately 75% of Independent telephones, gross plant investment, revenues and construction spending.

> **'Although lacking some details, the available data clearly reveal a telephone industry busily repositioning itself to cope with the new telecommunications realities.'**

Of the top 5 Independents, each forecasts increased construction spending in 1983; of the top 10 Independents, 7 forecast an increase; of the top 23 Independents, 14 plan to spend more.

Although lacking some desirable details, the available data clearly reveal a telephone industry busily repositioning itself to cope with the new telecommunications realities. The conventional indicators confirm slower growth or, more accurately, the maturity of an industry which largely has accomplished its mission of providing universal service at affordable rates.

The traditionally conservative industry now is responding conservatively to overall economic uncertainty and to certain but yet unmeasured effects on revenues and opportunities related to recent regulatory and judicial actions.

The SCCs

SCCs now are permanent and growing parts of the U.S. telecommunications scene although their combined revenues and market share are small in comparison with those of the traditional telephone industry (Table 6). Since only a few of the miscellaneous common carriers (MCCs) are classified as SCCs, a definition of the term is important.

In 1969, the FCC began collecting information from a group of licensees which provided domestic, point-to-point transmission service over their own microwave facilities. The transmissions mainly were one-way television signals to cable television (CATV) companies. These licensees were called "miscellaneous" common carriers.

Certain of these MCCs which began providing voice and data transmissions over their facilities in the early '70s became known as

Continued on page 36

Table 6 Toll Revenues ($000 omitted)

	Dec. 31, 1978	Dec. 31, 1981	Market Share 1978	Market Share 1981	% Growth 1978-1981
Bell System	$21,207,000	$30,919,000	82%	80%	+46
Independents	4,366,000	7,117,000	17%	18%	+63
MCI	78,167	413,131			+429
SPC	49,921	230,882			+362
USTS	8,873	82,641			+831

Source: Federal Communications Commission, Form P, Form M

Table 7 SCC Revenue, Expenses and Plant Investment, 1981-1982 ($000 omitted)

	Revenues	Expenses	Plant Investment Gross	Plant Investment Net
MCI Communications Corp.	$413,131	$382,245	$428,852	$409,980
N-Triple C*	6,328	5,378		
Southern Pacific Communications (SPC)	230,882	197,046	281,962	214,611
United States Transmission Systems Inc. (USTS)	82,641	73,970	119,872	98,763
U.S. Telephone Communications (U.S. Tel)**	24,000	20,000	16,000	15,400
Business Telecommunications (Bus Tel)	1,258	911	893	635
Transportation Microwave (TransMicro)	957	808	3,204	1,472
	$759,197	$680,358	$850,783	$740,861

Source: figures taken from Form P, Annual Report of Miscellaneous Common Carriers, filed by each of the cited carriers with the FCC. MCI gross and net plant investment taken from MCI annual report in order to reflect total company.

*N-Triple C is a subsidiary of MCI; revenues and expenses estimated. Plant investment (gross and net) included in MCI totals.

**Estimated by U.S. Tel (fiscal year).

"specialized" common carriers, a term based primarily on the voice and data source of their revenues.

On this basis, only 6 of the 57 MCCs which report to the FCC can be classified as SCCs. These six (Table 7) had total revenues of $759.2 million in the calendar year 1981-82. Three of these SCCs, however, account for 97% of the total SCC plant investment, operating expense and revenue (Table 8).

For the same period, the other 51 MCCs had total revenues of $56.7 million of which 80% ($45.6 million) was derived from their traditional source, video-audio transmissions. The remaining revenue of $11 million, a very small share of the total MCC/SCC revenue, was derived from special transmission services including the lease of surplus capacity to SCCs; for instance, 63% of the MCC special services revenue ($11 million) accrues to three MCCs: Western Tele-Communications, Inc., Midwestern Relay Co. and American Microwave & Communications, Inc. Consequently, this review and forecast does not "double count" the $11 million by including it as SCC revenue.

'. . .explosive growth and the promise of untapped potential are, however, beyond reach unless the SCCs expand their networks. And that is exactly what the six major SCCs intend to do. . .'

Table 8 SCC Market Share and Cumulative Share

	Revenues		Expenses		Gross Plant	
	Share	Cumulative	Share	Cumulative	Share	Cumulative
MCI	54.4%		56.2%		50.4%	
N-Triple C	0.8%	55.2%	0.7%	56.9%	—	50.4%
SPC	30.4%	85.6%	29.0%	85.9%	33.1%	83.5%
USTS	10.9%	96.5%	10.9%	96.8%	14.1%	97.6%
U.S. Tel	3.2%	99.7%	3.0%	99.8%	1.9%	99.5%
Bus Tel	0.2%	99.9%	0.1%	99.9%	0.1%	99.6%
TransMicro	0.1%	100.0%	0.1%	100.0%	0.4%	100.0%

Toll revenues for the top SCCs, the Bell System and the Independents increased by 51% during the 3-year period of 1979 through 1981, the latest period for which data is available (Table 6). And although the SCCs currently have a small market share, even a 1% shift in their favor is significant in this multi-billion-dollar market.

Where such shifts might occur depends largely upon a specific SCC's marketing strategy and the value attributed to various segments of the market. Currently, the business user contributes the bulk of SCC revenues although SCCs now are aggressively exploiting the residential market.

MCI Communication Corp.'s residential customer base, for example, is growing dramatically: For the fiscal year ending in March 1982, the company reported total revenues of $506 million, up 116% over the previous fiscal year revenues of $270 million. Residential service was the fastest growing segment, increasing its contribution to total revenues from 13% to 27%. In October 1981, however, MCI's customer base consisted of 400,000 residential customers and 125,000 business customers. All of the residential customers were added after March 1980 and by December 1982, the customer base numbered 1 million—250,000 business; 750,000 residential.

Since the FCC's recent approval of competition in international voice and record transmission (TELEPHONY, Dec. 20, 1982, p. 12), some SCCs will become major contenders for new traffic or a share of existing traffic, especially from large, multinational corporations. Similarly, domestic corporate users with a large volume of point-to-point traffic will be continuing and lucrative targets of SCC activity.

Another source of revenue for SCCs is the resale of long distance service, an activity that virtually all of them are pursuing in varying degrees. Currently, resale is the major activity of U.S. Telephone Communications (U.S. Tel) although the company has announced a construction and leasing plan for an extensive private network. Also, independent resellers often use SCC circuits as essential parts of their capability.

The SCC record of explosive growth and the promise of untapped potential are, however, beyond reach unless the SCCs expand their networks. And that is exactly what the six major SCCs intend to do, spending an estimated $1.2 billion to $1.5 billion in 1983 and virtually doubling their plant investment.

Interconnect companies

No newcomers to the telecommunications scene, interconnect com-

Table 9 PBX and Key System Potential-1981 TELEPHONY Interconnect Survey

Employe Range	% Establishments Base: 4,400,000	% Employment Base: 65,000,000	Primary Equipment Applications (X—Probable; '—Possible) Bus Line	Bus Ext.	KTS	PBX -100	-200	-500	+500	KTS Behind PBX
1-4	58.0%	7.0%	X	X						
5-9	19.0%	9.0%	•	•	X					
10-19	11.0%	11.0%			X	•				
20-49	7.0%	16.0%			•	X				
50-99	3.0%	12.0%			•	X	•			
100-249	1.3%	13.7%				•	X			•
250-499	0.4%	9.4%					X	X	•	•
500-999	0.2%	7.9%						X	X	•
1000+	0.1%	14.6%						•	X	•

panies have been a major force in reshaping United States policy and in wooing a substantial part of the business communications market away from traditional telephone companies. Some facts often are obscured, however, by the promotional "clutter" which is characteristic of business communications marketing:

- There is only one business user market, the same one that already existed. Now, alternate suppliers offer a greater variety of PBXs (private branch exchanges), key systems and the like which only provide traditional voice communications although more efficiently. Expanding the market beyond this traditional dimension mainly depends on the availability and marketability of integrated or automated office systems and equipment, an area of current intense activity by all major suppliers.
- Only 20 large parent companies, affiliates and franchisees of companies such as Executone, Rolm and the like, account for almost 25% of the known 2300 interconnect company locations in the United States and 80% of the annual sales volume, according to TELEPHONY's 1981 survey. Moreover, some of the parent interconnect companies, such as Centel Business Systems and Executone, are either affiliates or subsidiaries of major telecommunications holding companies.
- Excepting information-intensive business establishments, probable PBX applications are limited to 10% of total U.S. establishments, those with 20 or more employes (Table 9).

Table 10 shows the interconnect companies' PBX and key system customer base and the distribution of the base between all the companies and the 20 parent-affiliated companies.

TELEPHONY's 1982 interconnect survey further defined the composition of the interconnect customer base, showing more clearly the part supplied by independent interconnect companies and the 20 parent-affiliated interconnect companies (Table 11). The summary clearly shows that the share of the large PBX customer base increases for the affiliated interconnect companies.

Each interconnect segment also fits very precisely into the U.S. business establishment segments (Table 12). Establishments with one to nine employes, for example, comprise 77% of the total establishments but only 16% of U.S. employment in private industry. This business sector increasingly will be served by local contractor, retail-type communications suppliers. Independent, non-affiliated, one-location interconnect companies mainly compete to serve business establishments having 10-49 employes. The 20 parent-affiliated companies compete fiercely to serve establishments with more than 50 employes, concentrating heavily on the top 5% of U.S. business establishments.

> **'Another complex factor is the state of the economy in the industrialized nations which are moving most rapidly into the "information age." Unemployment is a highly visible effect, at least partially related to this movement, and some telephone companies are reporting net losses in access lines. . .'**

A useful technique for estimating the current potential for PBXs in the top 5% establishments is illustrated in Table 13. Each establishment is counted as a potential PBX installation and the average lines per system are estimated by using a factor of 1.23, the U.S. central office (CO) Centrex ratio of employe to lines. Comparing these estimated system sizes to a group of 160 Rolm systems installed in the northeastern U.S. verified the accuracy of the technique. The factor does not apply, however, to large manufacturing and basic industry establishments having more than 500 employes and telecommunications demand quite different from that of a service industry.

The data in Table 13 also correlates with the estimates in the North American Telecommunications

Table 10 1981 TELEPHONY Interconnect Survey Results

Customer Base	Total Interconnect Companies	20 Parent-Affiliated Interconnect Companies
Key systems	66%	32%
PBXs up to 100 lines	17%	39%
100-499 lines	13%	50%
above 500 lines	4%	67%

Table 11 1982 TELEPHONY Interconnect Survey Summary

Interconnect company **Employe range (total)**	1-10 (33)	11-20 (29)	21-30 (33)	31-40 (32)	41-99 (17)	100 & Over (36)
% Parent-affiliated companies	6%	17%	30%	22%	41%	58%
PBX Installed Base						
up to 100 lines	297 93%	565 82%	1,446 74%	1,043 76%	893 63%	8,304 53%
100-250 lines	19 6%	104 15%	407 21%	246 18%	353 25%	4,828 30%
above 250 lines	3 1%	19 3%	95 5%	73 5%	166 12%	2,679 17%
Key System Installed Base						
Stand-alone Systems	4,413	5,750	8,443	11,032	6,107	23,975
Behind PBX Systems	74	221	733	532	604	7,018
Customer Base Characteristics						
Median Average Employes	15	25	40	35	50	60
Employes Range	5-100	8-100	12-100	6-125	20-800	17-1,500
Cluster Range	8-30	15-50	20-60	20-50	30-100	30-200
Sales (000 omitted)						
1982: Dollar Range	$150-1,200	$195-1,875	$700-5,550	$525-7,400	$2,500-15,500	$6,000-380,000
Cluster Dollar Range	$300-750	$500-1,250	$1,500-2,200	$2,300-3,100	$2,800-6,400	$11,000-22,000
Median Average Sales	$450	$800	$2,000	$2,500	$4,500	$15,000
1983: Dollar Range	$200-2,000	$240-2,500	$800-8,000	$750-14,000	$3,000-16,100	$7,000-530,000
Cluster Dollar Range	$500-1,000	$1,000-2,000	$2,000-3,000	$3,000-3,500	$3,500-8,000	$12,000-35,000
Median Average Sales	$750	$1,300	$2,400	$3,000	$6,000	$20,000
1982-83 Median Average % Growth Sales	+60%	+40%	+30%	+35%	+33%	+29%

Assn.'s (NATA) "1982 Telecommunications Equipment Industry Statistical Review." This report, authored by The Eastern Management Group, estimates a current total of 192,000 installed PBX systems and, by the end of 1985, 247,000 installed systems.

Although useful, these data should be weighed carefully against other important factors which now cannot be quantified accurately. A migration away from central office Centrex, for example, would result in an increase in the number of PBX installations. Bell operating companies, however, are beginning to suggest enhancement of Centrex rather than abandonment.

> **'Major U.S. users. . .are more than passive consumers of telecommunications equipment and carrier services. They already have demonstrated their will and power in reshaping. . .policy. . .And this telecommunications "revolution" is spreading throughout the. . .world. . .'**

Another complex factor is the state of the economy in the industrialized nations which are moving most rapidly into the "information age." Unemployment is a highly visible effect, at least partially related to this movement, and some telephone companies are reporting net losses in access lines, negative impact on revenue and the like for 1982. The effect on business customer plans to install or expand information management systems and equipment is difficult to measure.

Yet this area, according to the NATA report, presents interconnect companies with substantial growth opportunities, "servicing and selling add-on equipment such as data terminals to established customers."

The business customer clearly is the one lucrative target in the sights of all communications suppliers.

And, if interconnect companies have their way (TELEPHONY, Dec. 13, 1982, p. 11), the Bell operating companies will be required to form separate subsidiaries. Then, the U.S. business customer will have only two real choices for telecommunications equipment: dealing directly with a manufacturer or with an interconnect-type company.

Large private users

TELEPHONY's 1981 survey of the Fortune 1000 industrial companies and 300 service organizations revealed that their professional telecommunications managers have network and financial responsibilities comparable to those of small to mid-sized telephone companies. Some of their organizations have annual sales—not assets—exceeding the budgets of many nations. According to the survey, these companies spent $25 billion in 1981 for telecommunications equipment and services. Assuming a 12% increase including adjustment for inflation yields a conservative estimate of $28 billion spent in 1982. Applying the 20/80 rule of thumb provides an estimate of $35 billion spent by the total private sector in 1982.

TELEPHONY recently surveyed this same group of telecommunications managers in order to quantify their purchasing responsibility for voice and data communications equipment and services. The results (Table 14) confirm that the Fortune companies' top management places a high value on these professionals and relies confidently on their judgment: More than 90% of them have full responsibility for determining need, evaluating services and equipment and selecting vendors. More than half of them have final purchase authority.

More than 60% of the telecommunications managers are involved in evaluating and selecting data communications equipment; 34% of them have purchasing authority.

Only 21% of them are not invovled in data communications, mainly because their companies have little or no such requirements.

Some form of merged or integrated

Continued on page 40

Table 12 Distribution of U.S. Business Customer Base by PBX and Interconnect Company

Employe Range	% Establishments	Customer Base: Median Average	Customer Base: Cluster Range	Employes Total Range	PBX Customer Base -100	PBX Customer Base 100-250	PBX Customer Base +250	Median Average Sales Per Location: Sales (000 Omit) 1982	Median Average Sales Per Location: Sales (000 Omit) 1983	1982-83 %Projected Growth	% Locations Parent-Affiliated Interconnects
1-4	58.0%										
5-9	19.0										
10-19	11.0	15	8-30	5-100	93%	6%	1%	$ 450	$ 750	+60%	6%
20-49	7.0	25	15-50	8-100	82%	15%	3%	800	1,300	+40%	17%
50-99	3.0	35	20-50	6-125	76%	18%	5%	2,500	3,000	+35%	22%
		40	20-60	12-100	74%	21%	5%	2,000	2,400	+30%	30%
Over 100	2.0	50	30-100	20-800	63%	25%	12%	4,500	6,000	+33%	41%
		60	30-200	17-1,500	53%	30%	17%	15,000	20,000	+29%	58%

Table 13 Top 5% of U.S. Private Business Establishments

Employe Range	Number of Establishments	Total Employes	Average Employes	Average Lines	160 Rolm PBX Installed Systems (Northeast U.S.)
50-99	132,000	7,500,000	57	48	50
100-249	57,200	8,905,000	156	126	145
250-499	17,600	6,110,000	347	282	322
500-999	8,800	5,135,000	583	474	633
+1,000	4,400	9,490,000	2,156	1,752	633

voice and data communications responsibility already has occurred in companies with annual communications expenditures of $5 million or more. Only 34% of these companies maintain distinctly separate departments for each function. Typically, companies in this expenditure range each have 250 locations with 10 or more employes at each location.

Of the companies participating in the survey, 68 percent use the services of one or more SCCs—76% use MCI; 24%, SPC (Southern Pacific Communications); 9%, ITT/USTS (International Telephone & Telegraph Corp./United States Transmission Systems Inc.); and 1%, others.

Reselling communications services currently involves only 1% of the companies, although 15% of them plan to do so, beginning in 1983 or 1984. Twenty two percent of the participating companies already have local area networks (LANs) and more are planned for 1983. Organizations spending $5 million or more annually own 83% of the private microwave networks and 48% of the private mobile networks.

Centrex currently serves 50% of the companies of whom 64% plan to discontinue Centrex within 2 years; 36%, within 4 years. (This announcement of the death of Centrex may be greatly exaggerated because the Bell operating companies may enhance the service, prolonging its life.)

The major group of U.S. companies spending substantial sums for international voice and data telecommunications services is not identical with the large-user, domestic group, according to a recent survey prepared for the National Telecommunications and Information Administration (NTIA) by Martech Strategies, Inc. Of the companies surveyed, however, 81% annually spend more than $500 thousand and the total universe of these companies is estimated at approximately 100. There are thousands of companies in the groups spending lesser amounts of money.

The survey, "Present and Projected Business Utilization of International Telecommunications," also indicated that the number of worldwide voice-data circuits of major users was more than double the number of circuits terminating in the United States.

Major U.S. domestic and international users are, therefore, more than passive consumers of telecommunications equipment and carrier services. They already have demonstrated their will and power in reshaping the telecommunications policy of the United States. And this telecommunications "revolution" now is spreading throughout the industrialized world. ☐

Table 14 Leading Characteristics of Large Business Users of Telecommunications Equipment and Services

Communications manager responsibility	**Voice Communications**	**Data Communications**
Determine need	96%	48%
Evaluate services/equipment	93%	69%
Select vendors	90%	61%
Approve purchase	55%	34%
Not involved	0%	21%
Communications manager responsibility vs. company's annual telecom expenditure		
Under $100,000	0%	10%
$100,000-500,000	6%	9%
$500,000-1 million	5%	23%
$1 million-5 million	23%	35%
Over $5 million	66%	23%

Departmental reporting responsibility vs. company's annual telecom expenditure	**Separate Depts.**	**VoiceCom Reports to Datacom**	**Integrated Depts.**	**DataCom Reports to VoiceCom**
$100,000-500,000	40%	60%		
$500,000-1 million	50%	50%		
$1 million-5 million	50%	44%	6%	
Over $5 million	34%	26%	36%	4%

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French market trial yields usage statistics

Videotex services have become increasingly sophisticated and, not coincidentally, increasingly attractive to users. France has been particularly active in the field. This article takes a look at the latest videotex news from France and pays particular attention to hard data on usage patterns which have recently become available. The article was adapted from material that appeared in the December 1982 issue of Telematique News, published by Intelmatique, Paris, France.

SINCE ITS INCEPTION as a market experiment nearly 2 years ago, the Teletel 3V (T3V) videotex trial has grown sharply from an initial base of 84 different services in January 1981 to 190 today. There are 165 French companies participating.

During this growth, the managers of the trial discovered the need to redefine some of the terms that had sprung up with the advent of videotex.

"Information providers" was one of those terms.

"It had outlived its usefulness," said Georges Nahon, marketing director for Intelmatique. "We substituted the phrase 'service provider' because it better defined how all types of businesses contributed to the system.

"Home banking and shopping, and the ability to make transportation and hotel reservations from your terminal are genuine services.

"Even those businesses whose chief product is information—the daily press, radio and TV, for instance—are also providing an important service."

More than 100,000 frames of information are currently available through the Velizy computer center, 60,000 of them at the center itself, and an additional 40,000 to 50,000 at remote databases. In addition, the execution services available probably account for millions of additional pages.

Twenty-four remote computers are connected to the Velizy center through a *distributed gateway;* eleven through TRANSPAC, the national packet switching network; and 13 through leased lines. All use the X.25 protocol.

The remote computers are of eight different kinds; Logabox, IBM, Hewlett Packard, Mitra (SEMS-THOMPSON), DEC, Data General, CII-Honeywell Bull (HB66) and Honeywell DPS6.

Six Honeywell DPS6 computers are located at the Velizy center.

Operators of the 24 remote computers maintain their own databases, and create and delete pages as they wish.

Editing terminals being used are X-COM, UNITEL and FIET. Each terminal includes an editing keyboard, a decoder and a floppy disk controller. Generally, service providers have

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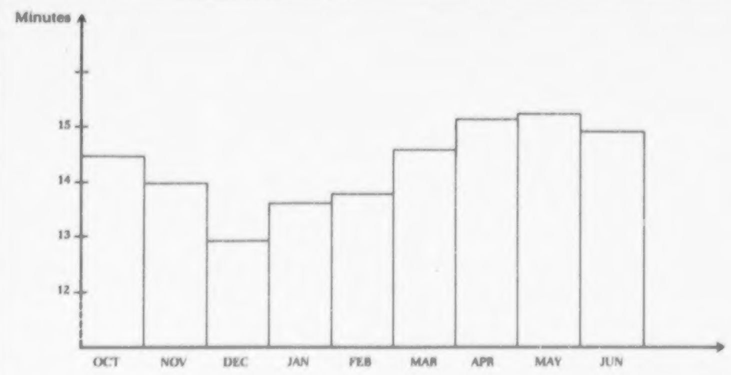
(Percentage of usage out of each 100 calls)

	No. of services	June 1982	Oct. 1982
Groceries, Food Industry	6	2.7%	1.5%
Insurance Companies	14	1.6%	0.7%
Car Industry/Motorcycles	4	2.3%	1.5%
Financial Companies/Stock Exchange/Banks	14	9.0%	8.2%
Retail (non-transactional)	19	2.4%	2.4%
Mail Order (transactional)	3	2.9%	1.6%
Energy Saving (oil company sponsors)	6	0.4%	0.2%
Market Studies (videotex advice, consultants)	8	0.4%	0.2%
Real Estate/Appliances	6	0.6%	1.0%
Home Entertainment (games, quizzes)	4	2.3%	2.6%
Press/Entertainment Guide/Radio-T.V.	25	27.1%	29.7%
*Local Administrations	10	1.4%	1.5%
*Administrations	25	2.1%	2.4%
Transportation/Tourism/Travel	19	8.2%	6.7%
Education	10	4.4%	3.4%
Others	10	0.5%	0.4%
Teletel Index/Instructions/Daily Highlights	6	21.6%	28.1%
Mail Service	1	10.0%	7.9%
	190	100.0%	100.0%

*Local and National Directory of Services and Departments

FIG. 1 *The breakdown of calls by the business sector.*



1981-1982	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
BASIC SAMPLE	14' 27''	14'' 04''	12' 57''	13' 36''	13' 47''	14' 31''	15' 09''	15' 12''	14' 55''

FIG. 2 *Average duration of a call.*

1981 - 1982	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
AM 0 - 8	2.2	2.1	2.4	3.1	2.6	2.5	3.2	3.4	3.3
AM 8 - 12	16.7	18.3	17.3	16.7	17.9	17.6	19.1	18.6	18.5
PM 12 - 2	13.5	13.3	13.2	13.9	13.2	13	13.2	12.8	12.7
PM 2 - 6	26.7	27.7	28.3	26.8	27.7	26.1	24.3	26.1	24.6
PM 6 - 8	23.2	20.5	21.5	20.7	19.6	21.5	21.1	20.2	18.8
PM 8 - 12	17.7	18.1	17.3	18.8	19	19.3	19.1	18.9	22.1

FIG. 3 *Teletel calls per hour.*

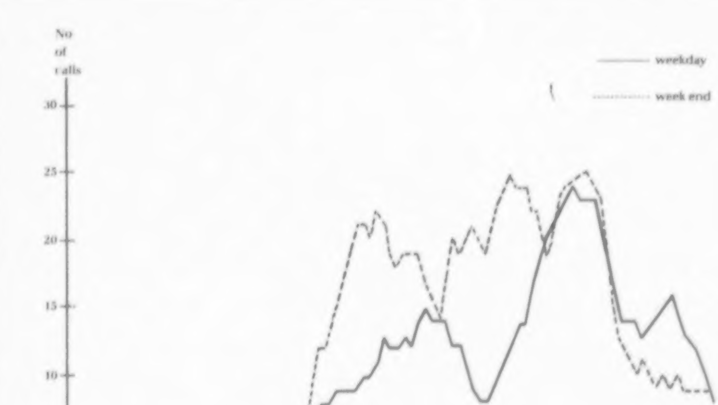


FIG. 4 *Average daily videotex traffic.*

the option of adding a camera, a digital tablet and a light pen. The terminal works either on line or off line (with storage on floppy disk).

For service providers that require frequent page replacement on a daily or weekly basis, an automatic system is in operation which electronically connects to, and creates videotex pages from, the material going to their printers.

This was especially necessary for JEF (Journal Electronique Francais), a consortium of news media, and for Parisien Libere, which provides the entertainment guide for France.

Hard data about videotex usage, of course, is important. Data collected during a 9-month period in a statistical study of the 2200 families involved in the T3V market trial are summarized in Figures 1 through 4. Here are some important facts about videotex usage:

- The busiest hour of the day is around 6 p.m.
- Saturday is the busiest day, but Wednesday is a close second.
- Some of the factors that influence usage are age, career status and education.

Since October 1981, the videotex computer center operated by the national French telecom administration (PTT) at Velizy, a Paris suburb, has tracked every videotex call made in the test area. Analysis of the results is expected to help French authorities determine user acceptability of the transactional technology, as well as consumer needs.

The major objectives of the French videotex trial were to define and evaluate in real terms the different social, cultural, economic and technical effects of this new communications medium.

Experts in the PTT currently are studying the raw data and are expected to issue a complete, analytical report.

The study revealed some interesting data for the experts. For instance, an average of 3.6 service providers are accessed during each videotex connection. Videotex calls averaged 14.5 minutes each. Of the videotex homes, 63% used the system more often than once a week. The average cost to each videotex household was only 12.6 francs (less than $2.00) per month by June 1982.

Although the larger the size of the family, the greater was the usage of videotex, there was no early indication that children would abuse the

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system. However, high videotex usage on Wednesdays was explained by the presence of children in the household, because Wednesday is not a school day in France.

Heads of households were divided into seven socio-economic categories: professionals, craftsmen, senior executives, middle managment executives, white-collar and blue-collar workers, and retirees.

According to the number of videotex calls made per month, and the frequency of usage, executives had the greatest need for information and used the service most frequently.

As for services, the undisputed leader was the database on news and entertainment information, which also offered some video games and other popular items like a Chinese horoscope. Page charges for this database were introduced last May, with only a slight, and apparently temporary, drop in demand for the service. The charge is 2 centimes per page.

Electronic mail also proved to be one of the most popular services. Of the 3305 terminals installed for the trial (2241 in homes), 1875 users have subscribed for the service, known as M3V. It averages 1500 calls per week.

Common interest groups (CIGs) have been established within M3V so the service can be used as a bulletin board or newsletter. Each subscriber is entitled to form up to nine different CIGs, with a maximum of 40 persons in each group. So far, 343 different groups have been formed in M3V.

Charges for M3V range from 50 centimes (about $1.20 an hour) for writing or answering a message, or sending one of the 65 postcards available.

It costs nothing to subscribe or to create or modify a common interest group.

The flat rate charge for distributing a single message to a CIG is 3 francs, or about 42¢.

How these rather small fees can be collected in a profitable manner is a question that is now being studied in France. □

T3V analysis

ROY D. BRIGHT

THE FIRST USERS of T3V were connected during March and April of 1981. Twenty months later more than 3000 terminals are active, of which some 2200 households represent the research sample while the balance are in the hands of service providers, the PTT's Velizy team and other specialist interests.

As a market research tool, its primary function, the trial has now been terminated although the system continues to be available to existing participants.

From its inception in 1979, T3V was planned to be run on third party databases but, to meet strong local demand, the final configuration combined a central database (retrieval function) with the ability to switch the caller to distant third party databases such as mail order or banking centers. These databases were added during the second and third quarters of 1981 resulting in a wide variety of applications among the 24 remote centers. One of the last to be added was the M3V (electronic mailbox) service.

The 9-month period used for the trial commenced in October 1981—some time after the majority of households were first connected, thus allowing for decay in the novelty factor, which is observable in all videotex trials.

Conversely, however, the number of services available grew from fewer than 100 to nearly 190 during this period, thereby stimulating additional interest as the user population matured.

The incidence and pattern of usage needs a more refined analysis than the general arithmetical average can provide. Whereas the average user made between 6.2 and 8.0 calls per month, analysis of the heavy user (defined as a household making at least one access per week) shows a fairly constant activity of between 14.8 and 16.2 calls per month. Average connect time, on the other hand, was static at approximately 14.5 minutes for most users, while frames accessed per call were also regularly recorded at about 47 frames for the whole 9 months.

Within the household, the husband was the most frequent user with a total of nearly 45% of all calls to his credit. The wife accounted for around 15% while children over 18 added a further 12% to the total. School holidays distort not only the seasonal but also the weekly pattern.

Turning to popularity of services, press and publishing, which includes radio and TV, beats its nearest rival, financial and stock exchange information, by three calls to one when weighted by the percentage of services offered in each sector. Using this same measure, administration drops to 3.1% while travel and tourism increases to 12%.

One subject which tends to distort the table of popularity is the inclusion of the Teletel index and user magazine. Some users might use the index frames a number of times during one session if they chose not to use the keyboard facility. Thus its inclusion—though statistically sound—results in a dilution of the commercial ranking.

This and many other issues may be debated but underlying this entire exercise is an encouraging sense of continuing development of consumer interest. The healthy vitality of the transactional and other execution services is illustrated by the electronic mail and bulletin board with 1875 registered users (out of the 3000 total terminal population) averaging almost one call per user per week which is remarkable for such a small sample population. Although the decoder was provided free of charge, users paid the local telephone charge (9¢ for the second and subsequent 5 minutes durations) plus frame charges, where required by the service providers, as well as further 9¢ per 5 minutes for message creation plus 8¢ for each message sent or filed.

To summarize, the prime objective of the T3V trial—which was to assess socio-economic and marketing, rather than technical, issues—has been achieved. These results seem to suggest that there is a viable mass-market opportunity for a well-rounded videotex service which combines the inherent capability to offer up-to-date information services with the added-value features of tele-shopping, telebanking, reservation and other interactive services.

The long-term future of Teletel videotex will be the subject of close scrutiny in France in the coming months with two reports being submitted to the Parliament and the Senate respectively before a final decision is made, but most observers believe that these results, coupled with the growing momentum of the electronic directory projects, should lead to an affirmative decision. □

Roy D. Bright is Managing Director of Intelmatique.

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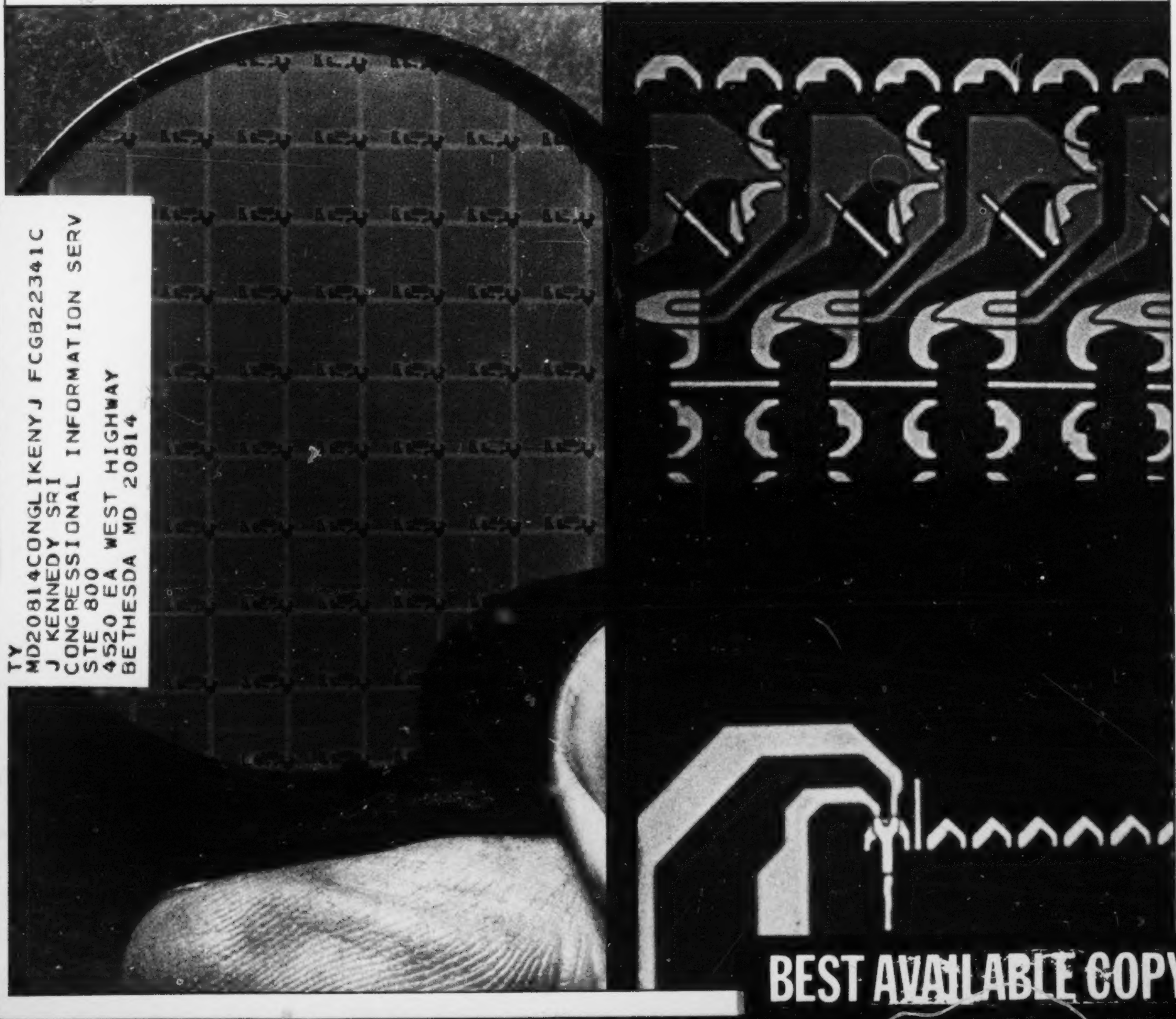

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World telecom spending to reach $78.5 billion level this year

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JANICE DRUMMOND, TECHNICAL EDITORIAL DIRECTOR,
and CZATDANA INAN, DIRECTOR-MARKETING RESEARCH

TELEPHONY's 1983 Annual Survey of International Telecommunications is the primary source of the information in this article. This year's survey was expanded substantially over previous ones in recognition of the United Nations resolution declaring 1983 World Communications Year and designating the International Telecommunication Union (ITU) as the lead agency for the Year.

The survey, a 12-page questionnaire published in English, French and Spanish, was sent to a selected sample of national telecommunications administrations and companies throughout the world. The queries solicited information on planned spending and plant investment but concentrated on the elusive goal of quantifying the world's existing telecommunications plant. Reaching that goal requires a continuing effort and the cooperation of telecommunications authorities throughout the world.

Consequently, all of the information gathered in TELEPHONY's 1983 survey and in subsequent surveys will be made available to the ITU for use by its members in quantifying their networks and identifying colleagues for information exchange.— *Ed.*

WORLD telecommunications spending excluding the United States will reach $49.7 billion in 1983. This estimate is based on a constant-dollar, weighted extrapolation of data received from 38 countries serving 64% of the world's 320 million non-U.S. telephones.

This estimate represents a 6% real increase over 1982 spending ($46.9 billion in constant dollars), and the first significant increase since 1980 and 1981. Then, the constant-dollar spending levels were $45 billion and $45.4 billion respectively.

World telecommunications spending, including figures for the United States (TELEPHONY, Jan. 10, p. 26), will reach a level of $78.6 billion, an amount approximately equal to 17% of the world's total estimated $453.4-billion investment in telecommunications plant.

The correlation between projected spending and total plant investment is very important because plant does wear out. Merely maintaining the status quo requires substantial spending.

Spending projections, of course, provide a benchmark for measuring the fiscal health of the industry on a yearly basis. For the telecommunications administrations (PTTs) and companies, however, the composition of the installed plant is the bottom line against which all capital expenditures must be measured.

In many countries, the 1983 budget allocations closely follow the spending projections made in 1982. This indicates that these administrations are pushing hard and successfully against recessionary pressures to complete projects that were funded partially in previous budgets.

The composite plant statistics (Tables 1, 2, 3 and 4) are only a small part of the data collected in the survey, but they reveal a familiar picture—a world of telecommunications abundance contrasted with telecommunications scarcity.

The countries are grouped by zones based on the International Telephone World Number Zone Plan, guidelines of the International Telegraph & Telephone Consultative Committee (CCITT).

If total telephones versus population is the chosen measure of telecommunications development, Sweden currently leads the world with some 83 telephones per 100 inhabitants.

This measure is unrealistic, however, in many countries that still are developing their networks. There, the relation between the number of business main lines and the number of business establishments may be the best measure of both telecommunications development and its contribution to overall national development.

In industrialized nations, the number of modems, telex terminals, private branch exchanges (PBXs) and key systems is a measure of network sophistication and an indication of the change occurring in the country's economic base. Switzerland and Belgium, for example, are information-intensive societies, and each nation has a disproportionate share of business communications users with respect to Europe.

The changes in the world's economic base—from manufacturing to information in the industrialized nations; from agrarian to manufacturing in the industrializing nations—are well known. Table 1 reveals, how-

Continued on page 41

Table 1

Europe

(Data as of Jan. 1, 1982, unless otherwise indicated)

		Lines			Switches	
Zones 3 and 4	**Total Telephones**	**Equipped**	**In Service**	**Total Exch**	**Local**	**Under 5000 Lines**
Austria	3,177,944				1440	
Belgium	3,820,000	2,940,300	90%		553	70%
Channel Islands						
Jersey	52,658	40,876	81%		6	67%
Guernsey	37,070					
Cyprus	143,000	111,850	77%		31	87%
Denmark[a]	3,316,708					
Jydsk Tel	1,287,722				697	95%
KLAS	1,780,000					
Finland	2,374,461					
Private		1,605,112	82%		1498	97%
PTT		711,000	74%		2226	99% +
France	24,686,319					
Germany	28,563,622	25,857,000	86%		6105	75%
Greece	2,796,435			3711		
Hungary	1,296,682			2505	2505	
Iceland	111,088			122		
Italy	20,450,000			10,019		
Ireland	715,000			1026		
Luxembourg	253,000	169,700	80%		43	81%
Malta	90,997					
Monaco	21,018					
Netherlands	7,230,000					
Norway	1,992,090	1,559,000	85%		3732	98%
Portugal[b]	1,371,731					
TLP		834,450	86%		79	54%
PTT		1,331,337			843	99%
Spain	11,844,623				2447	89%
Sweden	6,620,500	6,031,000	81%		6034	98%
Switzerland	2,924,876	3,729,590	78%		1026	
United Kingdom	27,961,646					
Kingston upon Hull	177,646			14		
PTT	27,784,000	21,258,000	89%		6315	78%

[a] Denmark has two other carriers, which account for the difference in the number of telephones.

[b] Portugal has two communication public service companies: Post & Telecommunications of Portugal (CTT) and Telephones of Lisbon & OPORTO (TLP). Both have the same Administrative Council.

[c] The United Kingdom has an additional 250,000 private (rented) payphones.

Table 2

Africa

AT&T Long Lines' publication, "The World's Telephones," shows a total of 5,028,177 telephones in Africa as of Jan. 1, 1981. Assuming 10% growth—the average growth exhibited by countries for which comparison could be made—there should have been 5,530,995 total telephones in Africa as of Jan. 1, 1982. The countries included in Table 2 for Africa represent 4,122,846, or 75%, of the continent's telephones. (Data as of Jan. 1, 1982, unless otherwise indicated)

		Lines			Switches	
Zone 2	**Total Telephones**	**Equipped**	**In Service**	**Total Exch**	**Local**	**Under 5000 Lines**
Ascension Islands	381	250	100%	2	2	100%

Public Phones	Modems	Telex Terminals	Systems	
			PBX	Key
23,326	12,323	21,076	9270	
7542	15,273	24,674	43,961	32,140
153	65	366	661	746
850	60	1889	1638	4200
			12,122	222
10,063	16,063		13,767	11,557
2988	4859	7320	5631	206
158,036	46,351	145,547		
4747	785		14,222	
16,275	882	8659	13,694	26,304
525	270		599	
125,296				
642		1769	1868	
554	0		579	
11,500	12,355	7925	15,326	19,900
	1250		15,160	30,720
14,118		9678		
40,000	39,000	16,000	40,218	13,599
33,000	19,063	39,012	104,737	193,041
1461			970	835
77,000[c]	81,547			

Public Phones	Modems	Telex Terminals	Systems	
			PBX	Key
0	0	7	4	

Continued on next page

ever, that the pace of telecommunications enhancement (or development) is matching or leading the shift in the economic base of the industrialized countries and lagging it in the industrializing countries.

In many nations, public telephones often are the only means of access for residential telecommunications service. An exchange frequently is equivalent to a local switch and an excess of lines equipped versus lines in service often means that lines are inoperable, not that capacity for new service exists.

The blank spaces in Table 1 do not always mean, therefore, that a country failed to respond to our survey. In many instances, it simply means there was no installed plant in that category or that the respondents considered it too minimal to report.

The vast continent of Africa, for example, illustrates the gigantic size of the telecommunications development task. With few exceptions, an exchange consists of a single local switch, most of them under 5000 lines in size. Indeed, most of the local switches have only a few hundred lines; for instance, in lower Egypt and the Suez Canal area, 125 switches serve approximately 21,000 lines—an average of fewer than 200 lines per switch.

Throughout Africa generally, telecommunications services are concentrated in commercial centers. Even there, the reported numbers of modems, telex terminals, PBXs and key systems were insufficient to allow an extrapolation for the entire continent. Both the reported data and the blank spaces in Table 1 clearly show that most administrations will continue to concentrate funds on developing the telecommunications networks in the commercial centers.

The industrialized countries also are concentrating on the further development or enhancement of the network for business purposes. The telecommunications liberalization trend which already has swept the United States and is spreading throughout the industrialized nations is being stimulated by business, not residential, telecommunications concerns. The United States, for example, has 38% of the world's telephones and 4.5 million business establishments of various sizes. France, Germany and the United Kingdom together have 7 million business establishments and only

Continued on page 43

Table 2...continued

Africa

	Total Telephones	Lines		Total Exch	Switches	
		Equipped	In Service		Local	Under 5000 Lines
Botswana	10,833			12		
Ethiopia	91,551			20		
Gambia	3744	2559	82%	13	9	100%
Lesotho	8800			34		
Mauritius	42,236				27	89%
Nigeria[a]	173,000			171		
Sierra Leone	12,500			13		
South Africa	3,208,730	1,970,915	86%	1620		
Swaziland	13,200			22		
Tanzania	93,238			133		
Togo	5850			10		
Tunisia	188,476			50		
Uganda	45,857			108		
Zimbabwe[b]	224,450			100		

a: In Nigeria, there were an estimated 171 exchanges in use in 1981. About 20% of those exchanges were equipped for subscriber trunk dialing. About 1910 PBXs and 205 PABXs were installed, with an average of 20 extensions. As of March 1981, about 1900 telex lines had been installed. Of the 2900 people on the waiting list for telex service, 1000 could be accommodated within the existing system.

b: In Zimbabwe, there are an estimated 7000 PBXs and key systems in service.

Table 3

Oceania, Asia, Middle East and Asia Minor

(Data as of Jan. 1, 1982, unless otherwise indicated)

	Total Telephones	Lines		Total Exch	Switches	
		Equipped	In Service		Local	Under 5000 Lines
Zone 6						
Australia	7,684,336			5460		
Brunei	37,800				14	100%
Indonesia	450,000			80		
Malaysia	716,810			435		
New Zealand	1,798,802			826		
Papua New Guinea	48,500			47		
Philippines	897,000			187		
Singapore	787,000	824,000	69%	24	73	15%
Thailand	529,100	482,454	83%	196	204	84%
Vanuatu	3000	1800	90%		2	100%
Solomon Islands	2500	1600	89%		2	100%
Zone 8						
China, PRC[a]		700,000				
China, Taiwan	3,400,000	4,071,680	69%		481	52%
Hong Kong	1,822,846	1,749,247	84%		56	37%
South Korea	4,179,921			267		
Macau	18,000	17,700	90%		4	75%
Japan[b]						
NTT	58,332,000			6500		
Zone 9						
Bahrain	72,564			11		
India[c]	2,785,000			7900		
Iran	1,018,181			428		
Israel	1,290,000				125	53%
Kuwait	232,000	294,200	58%		19	26%

Public Phones	Modems	Telex Terminals	PBX	Systems Key
	10		42	
817	3		795	
15	0	67	59	
37	0		514	
45			876	
			2100	
40	0		200	
29,703	19,184	25,211		
70			530	
323				
92			75	
600				
525			300	
856				

Public Phones	Modems	Telex Terminals	PBX	Systems Key
31,976	43,995			
25	10	327		
5005	2231		7696	17,723
420	107			
14,478	435	11,952	2958	4267
7187	2239	3325	763	NA
5	6	55	39	19
10	0		49	30
59,115	3661	15,170	2275	41,133
721	4033		1809	33,669
62,025				
12	12	184	202	
913,924			110,000	
6237	300+			
8000		4300	7556	
460		3009	1192	

Continued on next page

16% of the world's telephones.

The distribution of business telecommunications equipment in Europe and the U.S. dramatically illustrates the telecommunications intensification characteristic of the movement toward an information-based economy: Western Europe has in service an estimated 1.1 million PBXs, of which 90% are under the 100-line size, 500,000 modems and 800,000 telex terminals.

The U.S. currently has approximately 220,000 installed PBXs and 3.2 million key systems.

These impressive figures probably do not tell the whole story, because many nations allow network interconnection of privately owned business telecommunications equipment. It usually must be approved or certified by the telecommunications administration and rarely includes residential telephones. The U.S., of course, is a notable exception.

Among the countries currently reporting approval of equipment for private purchase and interconnection to the public network are Argentina, Australia, Austria, Belgium, Canada, Chile, Costa Rica, Cyprus, Federal Republic of Germany, Finland, Japan, Hong Kong, Kuwait, Luxembourg, Macau, Peru, Portugal, Saudi Arabia, Singapore, Syria, Taiwan, Thailand, Trinidad and Tobago, and Venezuela.

Although private ownership of equipment and approved interconnection to the public network sometimes are signs of telecommunications liberalization, they do not necessarily signal an open market for suppliers. These arrangements have existed for decades in many countries, for example, Germany, that have competent, well-protected national manufacturers.

Where developed national markets are opening to outside suppliers, however slowly, the approval and certification procedures usually are enforced to the letter. The procedures that are reasonable and necessary according to the host country often seem burdensome to outside suppliers.

Even developing countries with clearly established telecommunications needs and programs are not necessarily open to all suppliers. Often, the loans, grants or other aid include an understanding that equipment will be purchased from manufacturers of the aid-providing country.

The remainder of this 1983 World

Continued on page 45

Table 3...continued

Oceania, Asia, Middle East and Asia Minor

		Lines			Switches	
	Total Telephones	Equipped	In Service	Total Exch	Local	Under 5000 Lines
Pakistan	370,000					
Qatar	67,895			28		
Saudi Arabia	443,000	984,744	62%		165	57%
Syria	286,000	262,045	88%		36	47%
United Arab Emirates	242,327			58		

a: Only figures counted for the People's Republic of China are PTT figures. The government's sixth five-year plan, 1981-85, calls for $2 billion to $3 billion to be spent for telecommunications expansion.

b: The number of switches in Japan is based on the proceedings of the International Symposium on Subscriber Loops and Services (September 1982). The telephone network has four hierarchical office ranks. There are 8 regional centers, 81 district centers, 562 toll centers and approximately 6500 end offices. PBX figures are based on NTT reporting. "The Japanese Market for Communications Equipment and Services" (U.S. Dept. of Commerce, Pacific Projects Ltd.). NTT had, as of Dec. 31, 1981, 6,234,000 key system telephones. Distribution was believed to be 800,000 small key systems of one subscriber line and four stations. The rest of the key systems are between 2 to 8 lines and 6 to 20 stations. As of Dec. 31, 1981, there were 58,000 telex subscribers.

c: In India, 70% of the local switches are rural with an estimated capacity of 25 to 100 lines. In Bombay, there are an estimated 3195 public telephones, 528 PBXs and 5045 PMBXs.

Table 4

The Americas

(Data as of Jan. 1, 1982, unless otherwise indicated)

		Lines			Switches	
Zones 1 and 5	Total Telephones	Equipped	In Service	Total Exch	Local	Under 5000 Lines
Canada						
TransCanada System						
Alberta Gov't	1,298,700	931,310	77%		361	89%
Bell Canada	9,609,430	7,257,000	85%		1031	79%
British Col.	1,977,000	1,339,584	89%		314	80%
Manitoba	706,100	530,125	89%		262	90%
Maritime	498,200					
New Bruns.	391,100	262,000	90%		110	88%
Newfoundland	201,800	174,087	79%		66	91%
Saskatchewan	623,300	487,000	82%		375	95%
Edmonton Tel	662,000	453,400	73%		26	0%
Northern	76,100	47,000	93%		32	91%
Thunder Bay	88,800	61,825	85%		10	70%
Sogetel-Quebec	17,000	11,253	84%		13	100%
Quebec Tel	283,500					
Bahamas						
Grand Bah. Tel	15,315			2		
Bahama Tel	60,000	32,090	81%			
Barbados	66,600			8		
Bermuda	48,958	30,000	84%		5	80%
Costa Rica	207,717	189,611	85%		109	89%
Cuba	275,000					
Guatemala	148,596			52		
Jamaica	127,000	71,600	82%		41	89%
Nicaragua	56,000					
Panama	175,000					
Puerto Rico						
Puerto Rico Tel	679,458			100		
PR Comm Auth	72,200					

Public Phones	Modems	Telex Terminals	Systems PBX	Systems Key
			695	
1926		12,111		
223		900		

Public Phones	Modems	Telex Terminals	Systems PBX	Systems Key
76,079				
11,551	7500	350[a]	3346	16,290
		235[a]		
2887	1493		429	6058
2073	260		291	4900
3625	2689	272[a]	1118	4320
3075	4500	1800[a]	952	9257
470	82	26[a]		
580	140	0[a]	127	1725
97	14	2[a]	30	
112			37	329
181	17	520		
202			239	489
596	6		198	775
2679		1165	42	
922			600	
644		320	985	937
6200	1400		990	6500

Continued on next page

Telecommunications Survey contains comments from various administrations on their development plans, industry trends and, in a few instances, data which arrived too late for inclusion in the tables.

Prospects for the future

The Western developed countries' thrust for the immediate future is toward enhancing business telecommunication services and continuing work toward the integrated services digital network (ISDN). Edmonton Telephones and British Columbia Telephone Co., both Canadian companies, plan to continue their replacement of electromechanical switching equipment with digital equipment and to incorporate increasingly fiber optic technology into the network, initially at the interoffice trunking level.

Progress toward the ISDN, according to B.C. Tel's Vice President-Corporate Development Colin G. Patterson, should clarify the "dilemma over the location of intelligence vis-a-vis the network and terminals."

Patterson also pointed out that Canada's increasing liberalization of telecommunications policy will result in a highly active and competitive terminal equipment marketplace with suppliers eventually settling down to focus efforts on selected market niches.

In the U.K., another liberalization arena, development of competition is accompanied by keen interest in the possibilities technology holds for the business user. D. Wray, British Telecom's director-business planning and strategy development, noted that while most of the U.K. telephone network's physical expansion still is driven by increasing demands for voice services, "Within the network there is an accelerated drive toward integrated digital working providing flexible facilities for voice and non-voice telecommunications, including both narrow and wideband specialized services." Wray also speculated that the coming few years "could also see the start of a significant expansion on the wideband local network front, which the U.K. government is keen to see developed, not simply for cable television, but as the basic infrastructure for a society based on Information Technology including interactive and full video facilities."

Interests of the Deutsche Bundespost, Federal Republic of Germany,

Continued on page 47

Table 4...continued

The Americas

		Lines			Switches	
	Total Telephones	Equipped	In Service	Total Exch	Local	Under 5000 Lines
Trinidad and Tobago	83,000	56,800	79%		32	91%
Dominican Rep.	165,253			20		
Virgin Is. (U.S.)	44,285			6		
Mexico						
TELMEX[b]	5,275,000	2,870,644	95%		879	70%
Argentina						
Private	352,037	211,550	89%		60	77%
PTT	2,528,727	2,174,000	86%	1276		
Bolivia	135,000					
Brazil	8,159,000	5,936,944	89%		3502	
Chile	569,696	426,385	91%		247	89%
Colombia	1,623,105					
Ecuador	259,000			121		
El Salvador	72,700			42		
Paraguay	58,700					
Peru						
ENTEL	117,020	108,880	82%		100	92%
CPTSA	370,103					
Suriname	25,000					
Uruguay	287,140					
Venezuela	929,000	1,241,591	69%		449	85%

[a] These figures are for TWX, not telex, terminals. TWX service is used throughout Canada.

[b] Telefenos de Mexico, S.A. (TELMEX) is the PTT of Mexico. Direccion General de Telecomunicaciones (DGT) is responsible for the national microwave network, satellite communications and telex services. In 1980, telex connected 106 domestic locations (64 automatic exchanges and 42 through long distance bar), as well as connecting Mexico with 10 countries. Installed capacity was 11,000 terminals; 8131 terminals were in use.

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February 16, 1983

Public Phones	Modems	Telex Terminals	Systems PBX	Systems Key
259	0	253	629	40
740			414	1936
337			67	880
28.587			23.514	
1465			827	
17,150				
59,200	4042	50.130		
8857			2188	
21,000				
345				
955			3140	
1545			636	
18,407				

center on incorporating digital technology and fiber optics into the telecommunications network to provide traditional services as well as new ones. Specifically, German efforts will be directed toward development of the national interactive videotex service, Bildschirmtext, now undergoing field trial. The Bundespost expects to expand the system to handle 1 million subscribers by 1986. A national German telecommunication satellite also is under consideration as one element in a digital, optical fiber network for service-integrated facilities and broadband services. In the area of fiber optics itself, the Bundespost will purchase an average of 100,000 km of optical fiber cable each year for 10 years beginning in 1985, for use in its long distance network. One reason for this planned purchase, the Bundespost has indicated, is to provide optical cable manufactuers with a basis for calculation so they can work toward economical production methods and volumes.

Business interests likewise drive the Belgian telecommunications administration. Notable achievements and remaining goals pointed out by A. Serrure, general director of the

Continued on page 88

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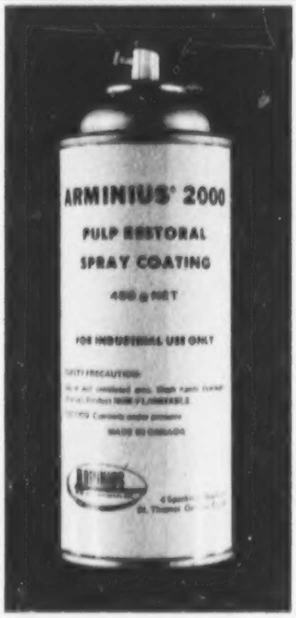

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Regie des Telegraphes et des Telephones (RTT), include 1982 initiation of a national data packet-switching network, Data Communication Service (DCS); and plans for a telex center, using time division multiplexing. In 1984, Serrure pointed out, the first telex subscribers will be able to be connected to this system with V21 modems. A teletex service also will become operational within the year, operating on the DCS network and will be interactive with telex service. Another service planned to make use of the DCS is a "mailbox" message service, scheduled for operation in late 1983.

Comments from two Scandinavian telecommunications operations, the Norwegian Telecommunications Administration and Jydsk Telefon in Denmark, indicated total and irrevocable commitments to digital technology. Jydsk Telefon's decision not to purchase more analog switching equipment went into effect Jan. 1. And, plans are underway to establish a broadband digital network using optical fibers.

For their part, the Norwegians are going digital in a big way, and the government has invited tenders from several digital switch suppliers for delivery of a total of 500,000 lines. In addition to two Norwegian companies, three foreign vendors have responded to the invitation, and one will be chosen this year. An order of 500,000 lines will serve to replace a major portion of the Norwegian telecom network, and the agency hopes to further reduce its telephone service waiting list, which in 1979 reached 94,000. The administration already has made inroads on this problem, and by the end of last year the waiting list had been halved, to approximately 47,000

The Norwegians anticipate full automatic service in 1985, when the automatic mobile radiotelephone service is planned to serve the entire country. (Norway already has 42,000 mobile radiotelephone subscribers, more than any other country in Europe).

Although separated by thousands of miles from Western Europe, Australia has nearly identical aims and ambitions for its telecommunications network. While demand at the top end of the PABX market is expected to be toward integrated voice/data systems, it also is expected that the lower market levels will continue to have their needs met with stored program control voice systems. Telecom Australia will introduce two new services: Digital Data Service (a high quality, end-to-end service designed for users with centralized teleprocessing applications); and AUSTPAC, a high performance, packet-switched data service.

At Hong Kong Telephone Co., Managing Director F.L. Walker anticipates steady growth in basic telephone service as a result of the creation of new towns throughout the territory. Hong Kong Tel currently has 1,749,247 equipped lines, with 84% in service. Of its 56 local switches, 37% have fewer than 5000 lines. And, liberalization trends also have shown themselves here: "With effect from Jan. 1, 1983, Hong Kong Telephone's non-franchised communication services were excluded from its government-imposed scheme of [financial] control, a profit limiting device. The company can thus compete with other suppliers on an equal footing. As a result, the company's diversification program, which now includes radio paging, viewdata, Financial Vision and Datel Message Service (using a store and forward transmission model), will continue to expand in 1983," Walker commented. The company also plans to offer premium telephone devices and services this year and an automatic mobile radiotelephone service that will provide local and international communication to land vehicles and pleasure boats in in-shore waters. This activity on the part of Hong Kong Tel may boost its current figures of 1809 PBXs, 33,669 key systems, 485 TWX terminals and 4033 modems.

Optical fiber installations are planned for the junction network, as well as digital switching.

Also on the Asian scene, Macau, with 17,700 equipped lines, is planning an underground ducted fiber optic system as the foundation of its new digital telephone system which will be initially equipped for 23,000 lines. This massive addition is scheduled for service in July. The new digital exchange will have international capability with "improved" terrestrial connections to Hong Kong and Guangdong Province in the People's Republic of China and other countries via a type B satellite terminal, according to Managing Director R.O.L. Histed.

If continued enhancement of an al-

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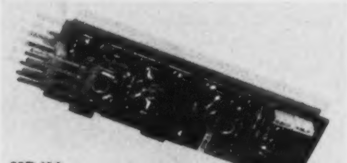
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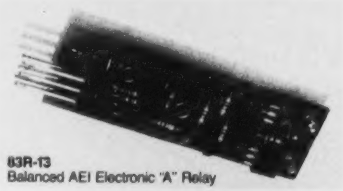
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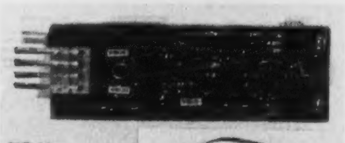
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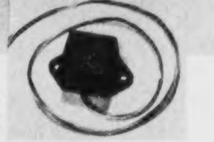
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ready refined network is the aim of most of the developed countries covered by TELEPHONY's survey, *establishment* of a solid, modern network is the goal of a number of still-developing nations.

For example, John Titus Narh Roberts, chief telecommunications engineer in Gambia's telecommunications department, explains, "Gambia is one of the few countries in West Africa still using the first generation type of switching equipment in its national telecommunications network. Due to the obsolescence of this equipment and the fact that it is becoming more and more difficult to maintain because of the scarcity of some essential parts, it has become absolutely necessary to replace the existing system."

The Gambia project, to be tendered early this year, will divide the country into three main Telephone Group Areas, each with a designated Group Center to which towns and villages will be linked through their respective local telephone exchanges by PCM (pulse code modulation) microwave channels. The completed, digital network will include an International Gateway Exchange and a national transit exchange for routing calls between Group Centers. The plan is to develop the network in two phases, but how firm the schedule is depends on funds availability, according to Roberts.

Zambia, says A. Kumar, assistant director-planning and development for the Posts & Telecommunications Corp., soon will commission 20 automatic rural exchanges, and radiotelephone systems to serve about 900 rural subscribers. A high capacity microwave link also is planned that will connect Zambia to the African nations of Botswana and Zimbabwe. A digital international exchange at Lusaka is planned for 1984.

On the other side of the Atlantic, Costa Rica will begin a project of digital switching installation that will give it a telephone density of 11 phones per 100 inhabitants, the highest figure in Central America, according to Marco Cruz, assistant director-engineering division, Instituto Costarricense de Electricidad. There, Cruz notes, plans are to serve 871 rural communities with rural public telephones; and approximately 510 telephones will be installed in "productive centers," such as farms, tourist resorts and rural industrial facilities.

Bermuda will begin replacing its electromechanical central offices with digital systems this year and shortly plans to achieve totally electronic switching networks.

In this all-electronic goal, Bermuda is joined by South Africa, where the object is to "phase out all existing electromechanical exchanges early in the next century," according to E. Stacey, director, Dept. of Posts & Telecommunications. Optical fiber cable systems will play a major role in digitizing the local junction networks. South Africa also will push business-oriented offerings, including a switched data network, electronic mail and electronic funds transfer systems.

A few telecommunications authorities contributed figures to TELEPHONY's survey too late to include in the tabular material. These include: Spain, lines equipped, 8,805,175, with 85% in service; local switches, 2973, with 86% of them having fewer than 5000 lines; PBXs, 34,588; key systems, 195,437. Israel has 1,039,900 lines equipped, with 89% of them in service; 125 local switches, 53% with fewer than 5000 lines; and 7556 PBXs. ☐

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Comparing costs vs. elasticity of demand guides satellite plans for the Pacific region

In 1981, researchers spent 7 months studying the communications needs in the Pacific basin area, and recommended use of satellite technology for this communications-poor region. Preliminary findings were summarized in TELEPHONY, April 26, 1982, p. 60. A follow-up study, discussed here, compared the feasibility of alternative satellite options and pricing scenarios.

MARCELLUS S. SNOW

TRAVELING for 7 months among the islands of the Pacific early in 1981, study team members of the Public Service Satellite Consortium (PSSC) talked to prime ministers, telecommunications officials and engineers, fishermen, village elders and other people about the need for better communications facilities. They heard a familiar litany of complaints: connections from the capital city to gateway cities on the rim of the Pacific, such as Sydney, Tokyo or Los Angeles, were often better than those between the capital city and hinterland villages a few miles apart, and existing local and rural service was poor and undependable.

The PSSC team reported its findings to the National Aeronautics and Space Administration (NASA) of the United States. Jane Hurd, one of the PSSC investigators, has summarized the NASA report in these pages (TELEPHONY, April 26, 1982, p. 60). Further work by PSSC professionals and other consultants was then undertaken at NASA's behest. I will summarize my role and findings in this consulting exercise with regard to alternatives for satellite service to the Pacific island areas in the near- and medium-term future.

As part of PSSC's follow-up study for NASA, I was asked by Elizabeth Young, PSSC's president, and Louis Bransford, vice president for planning and development, to examine certain aspects of providing satellite services to the Pacific basin. Specific topics were to include: a comparison of costs involved in using facilities of INTELSAT (International Telecommunications Satellite Organization) and INMARSAT (International Maritime Satellite Organization) to satisfy near-term needs; a discussion of meeting longer-term needs in the region; the role for improved telecommunications in promoting economic development in the Pacific; and various political and institutional considerations in upgrading telecommunications on a regional basis.

Other consultants for PSSC included Walter Morgan, a telecommunications engineer in the Washington, D.C., area; Don Lamberton, an economics professor at the University of Queensland, Australia; and Neil Karunaratne, also on the University of Queensland faculty and then serving as professor and head of the Dept. of Economics at the University of the South Pacific in Suva, Fiji. Hurd served as project coordinator.

Physically, my collaboration took me first to Washington in April 1982 for coordination of my efforts at PSSC headquarters; and 2 months later to Suva, Fiji, where I spent 1 week at the regional development office of the International Telecommunication Union (ITU). There, with access to the telecommunications experience and expertise of Graham Davey, ITU project manager, and his professional staff, I developed the data and methodology necessary to complete my report. In addition, the Suva visit put me in contact with Dr. Karunaratne, whose completed report for PSSC provided input data regarding traffic and facilities projections; it also gave me a chance to visit with officials of the South Pacific Bureau for Economic Cooperation (SPEC), a body long concerned with telecommunications needs in the Pacific.

My report for PSSC, completed in July, was included as part of PSSC's overall follow-up report to NASA, entitled "Satellite Communications for the Pacific Islands," which was issued last December. The Pacific Telecommunications Conference, held this January in Honolulu, offered opportunity to present my conclusions.

Any comparison of costs of alternative systems must presuppose estimates of traffic demand and facilities required to satisfy that demand. Ideally, demand would be developed in such a way as to depend on the price charged; price would depend on costs incurred; costs would depend on the extent and type of facilities provided; and facilities would in turn depend on demand. This type of interdependent system would best capture the many interrelationships involved. An economist, in particular, is loath to accept autonomously growing traffic projections arrived at by crude extrapolation from past trends, with no explicit assumptions about the relation of demand to the price of services. Nevertheless, constraints of time and methodology dictated a projection of traffic and facilities for the Pacific region which, while disaggregated quite minutely by source and type of traffic, had little explicit recognition of the price mechanism built into it.

In my portion of the work, traffic and facilities figures were broken down into two classifications. First, rural and urban traffic were kept distinct. In addition, the French-speaking areas of the Pacific (French Polynesia and New Caledonia) were treated separately because of their status as overseas departments of a metropolitan power that are not lo-

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cated on the Pacific rim area.

Initially, the INTELSAT and INMARSAT options were compared over the 7-year period from 1985 to 1991; then the option of a separate, dedicated, multipurpose system was examined for the 9-year period from 1992 through 2000.

Figures provided by Dr. Karunaratne projected total regional traffic growth from 30.2 million paid minutes (equivalent voice circuits) in 1985 to 59.4 million in 1991. Of this, 23.1 million (in 1985) and 49.7 million (in 1991) came from urban users. The demand in paid minutes was then translated into voice-grade circuits on the basis of the following equivalences supplied by telecommunications engineers: 1 circuit per 10,000 annual paid minutes for rural traffic, and 1 circuit per 20,000 annual paid minutes for urban traffic. This yielded a need for 1904 circuits regionwide in 1985, of which 1204 were urban, growing to 3534 in 1991, including 2574 urban.

Next, voice circuits were translated into equivalent earth stations, on the basis of advice from ITU experts. The ratios used were 1.33 circuits per year equal 1 earth station for rural traffic; and 4.0 circuits equal 1 earth station for urban traffic. These ratios presupposed particular types of antennas configured in particular ways. The requirement was made that earth station capacity to be installed in 1985 for the interim system, whether the space segment was to be furnished by INTELSAT or INMARSAT, would be sufficient to satisfy demand through 1991, the end of the interim period. This condition meant that 1271 earth stations would be needed in 1991, including 654 for urban traffic and 617 for rural usage.

Finally, satellite transponder requirements, on the basis of 600 to 700 voice circuits each, were projected. The need rises from three transponders in 1985 (two urban and one rural) to seven in 1991 (five urban and two rural).

Differing cost assumptions require separate treatment of the INTELSAT and INMARSAT options.

INTELSAT costs

The assumption was made that INTELSAT transponders would be used at the current lease rate for interruptible domestic service, which is $800,000 per year. This is a service which INTELSAT has made available since 1973 to dozens of user countries. INTELSAT space segment lease costs would accordingly grow from $2.4 million in 1985 to $5.6 million in 1991.

Earth station costs were calculated as follows: Each of the 18 political entities in the Pacific basin was assumed to require one large base earth station for domestic and international interconnectivity. These would be roughly equivalent to the INTELSAT B standard in quality and price, and were assumed to cost $1 million each. The remaining 1253 earth stations were assumed to cost $120,000 each, having dishes of approximately 6.5 meters in diameter and providing power of 10 watts per channel.

Each base earth station was assumed to need a full-time expatriate manager, at an annual salary growing from $31,000 in 1985 to $54,900 in 1991, and a senior technician would be required at every earth station at an annual salary increasing from $10,600 in 1985 to $18,800 in 1991.

Miscellaneous overhead was assumed to be $5000 per circuit per year, which was an arbitrary amount. This traffic-sensitive figure was allowed to cover recurring maintenance expenses, nontechnical labor and, importantly, construction and maintenance of terrestrial links from the earth stations to existing networks. Together, technician salaries and overhead yielded operating and maintenance costs which grew from $23.6 million in 1985 to $42.6 million in 1991.

Earth stations were depreciated over 15 years based on the assumption of an 8% loan over the same period—an interest rate clearly below market levels but reflecting options available from international development lenders such as the World Bank. Lasting 15 years, the earth stations would have more than one-half of their useful life remaining after the expiration of the interim period at the end of 1991. Earth station depreciation would account for $11.2 million annually during the 1985-91 period, while interest on the outstanding principal balance would decline from $13.3 million in 1985 to $9.5 million in 1991.

Adding costs of transponders, operation and maintenance, depreciation and interest yielded total system costs of $50.5 million for 1985, increasing to $68.9 million in 1991. This corresponded to a cost per circuit of $26,504 in 1985, declining to $19,509 in 1991. On the basis of cost per paid minute, the figures were $1.67 per paid minute in 1985, declining to $1.16 in 1991. Exclusion of traffic from French areas reduced total system costs by about 30% throughout the period, but lost economies of scale cause per circuit costs to increase to $28,942 in 1985 and to $21,193 in 1991. Similarly, omission of French traffic raised per minute costs to $2.02 in 1985 and to $1.36 in 1991.

INMARSAT costs

By using higher-powered and more expensive satellites than INTELSAT, INMARSAT allows cost savings in earth stations, which can be smaller, less expensive and have lower power. Furthermore, INMARSAT capacity is provided and tariffed on a demand assignment basis, meaning that links are established as needed, in lieu of circuits leased between pairs of member administrations.

In 1982, INMARSAT was charging its member administrations $5.25 per minute on a demand-assigned basis for a voice-grade circuit. Unlike INTELSAT, INMARSAT has not yet offered high-volume services at bulk or discount rates. If there was no assumption that lower rates could be offered to Pacific basin users, overall INMARSAT costs would exceed those of INTELSAT. Thus, the assumtion was made in the PSSC study, which involved difficult institutional ramifications, that one of two concessionary rates would be approved by INMARSAT: $2.00 per minute or $1.00 per minute. The same number of regular non-base earth stations was assumed for INTERSAT, and at the same cost. Five large regional earth stations were projected, rather than 18. Due to the higher power of the INMARSAT satellite, however, the regular earth stations could be cheaper: $50,000 each instead of $120,000. As before, $1 million was taken as the cost of the few large earth stations. Again, a 15-year, 8% loan was assumed. Maintenance and overhead were projected to fall from $5000 annually per circuit to $3000 in the INMARSAT case. While one technician per large earth station still would be needed, the simpler nature of the regular earth stations appeared to justify requiring one local senior technician per three such earth stations, keeping the number of senior technicians per dollar's worth of earth station constant in both the INTELSAT and INMARSAT scenarios.

When totaled, these INMARSAT expenses yielded per minute circuit costs of $2.67 in 1985 and $2.46 in 1991, assuming a $2.00 per minute

Table 1

Comparison of INTELSAT and INMARSAT costs for Pacific basin interim satellite system

INMARSAT total cost as percentage of INTELSAT total cost

	Including FP/NC		Excluding FP/NC	
Year	SS Cost = $2.00/min	SS Cost = $1.00/min	SS Cost = $2.00/min	SS Cost = $1.00/min
1985	159.9	100.1	139.0	89.4
1986	167.4	103.6	144.1	91.6
1987	173.8	106.7	152.8	96.0
1988	183.9	111.8	158.9	98.8
1989	192.1	115.8	168.6	103.8
1990	203.0	121.4	178.9	109.1
1991	211.8	125.7	186.8	112.6

space segment charge. These costs fell to $1.67 and $1.46, respectively, when a $1.00 charge was assumed. In contrast to the INTELSAT case, exclusion of French traffic from an INMARSAT system increased per minute costs by only 5% to 10%.

Table 1 compares INTELSAT costs with INMARSAT costs over the 9-year interim period. INTELSAT is superior on an overall cost basis; in some instances it has a more than two-to-one edge over INMARSAT. Only during the years 1985-1988, under the double assumptions of an extremely low INMARSAT space segment charge ($1 per minute) and exclusion of French traffic, does INMARSAT show a slight cost advantage.

The projected INTELSAT costs, roughly in the range from $1 to $2 per minute, compare favorably with prices presently being charged by Pacific basin telecommunications administrations. Fiji, for example, charges the equivalent of $1.69 per minute to all Pacific islands; and Papua New Guinea charges $1.50 per minute for calls to Australia.

A permanent system, 1992-2000

Despite the advantages of leasing space segment capacity for the near term, consideration should be given to acquisition by 1992 of a separate, dedicated satellite system owned by the Pacific basin entities. System ownership was to be vested in an organization with the form of an economic cooperative such as INTELSAT, in which investment percentages are periodically realigned to reflect recent past usage. Larger traffic requirements by then might make economies of scale strong enough to justify a separate system.

In addition, I urged that the system be multipurpose in nature, and not limited to conventional telecommunications. Use of the system for purposes such as earth resource surveys, meteorology, health, education and public administration would surely accelerate the process of economic development, which in turn is linked with the expansion of telecommunications demand, capacity, quality and variety. Also, international lending agencies such as the World Bank would look more favorably on a system that took developmental requirements into account more explicitly. On the basis of less elaborate methodology and bolder assumptions, a permanent, dedicated system was found to yield annual per-circuit costs of $7000 to $10,000 by the year 2000, compared with per-circuit costs of roughly $19,500 to $24,500 for 1991, the end of the interim period.

Recovery of costs

Average-cost pricing, while administratively convenient and conceptually straightforward, does not take into account the cost of the last—or marginal—unit provided, or variations in the ability to pay—elasticity of demand—among different user groups. For this reason, it is a relatively inefficient way to recover costs. The overall economic welfare of users can be better promoted by other charging methods.

One pricing approach often proposed is marginal-cost pricing, which involves charging the cost of the last or marginal unit provided. While this procedure has desirable welfare characteristics, it fails to recover total costs in industries such as telecommunications which enjoy economies of scale, since marginal costs are then less than average costs. A second-best solution often discussed by economists and occasionally applied in practice is inverse-elasticity pricing, often called Ramsey pricing.

Basically, inverse-elasticity pricing involves charging markups above marginal cost in inverse proportion to the price elasticity of demand—ability to pay and sensitivity to price—of different user groups. This means, in practice, that users relatively sensitive to price—those with high demand elasticities—are charged less than users relatively insensitive to price, who have low demand elasticities.

Economies of scale make marginal-cost pricing impossible in the INTELSAT case, so I compared average-cost and inverse-elasticity pricing scenarios, along with two hybrid tariff structures. For the average-cost case, both urban and rural users were charged $26,504 in 1985, which exactly captured total operating costs. To illustrate inverse-elasticity pricing, I assumed an urban price elasticity of demand of -0.8, and a rural elasticity of -1.2; thus, in absolute terms, rural users were assumed, with considerable empirical and theoretical justification, to be more price-sensitive. (The figure -1.2 means that a 1.0% increase in price causes a 1.2% decrease in demand.)

Application of the Ramsey pricing criterion indicated an approximate charge of $30,000 per circuit to urban users and $11,250 to rural users. Because they are only slightly price-conscious, urban users reduced their circuit demand minimally, from 1204 to 1090 circuits; while the large price reduction for rural users raised circuit demand from 700 to 2017. In this way, total circuits increased from 1904 to 3107, while total costs increased only slightly, from $50.5 million to $56.5 million. Total costs continued to be covered under Ramsey pricing, and rural users had their aggregate welfare greatly increased with more circuits used at a lower price, at only a small welfare loss to urban users who used slightly fewer circuits due to the higher price.

Much debate has been devoted to the question: "Does improved telecommunications cause economic development, or is it the other way around?" To assume or to require that the causality be unambiguously in one of two directions is simplistic. Both directions of causality can be accommodated, for example, in an econometric system of simultaneous equations. The concept of bidirec-

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tional causality between telecommunications infrastructure and development causes no theoretical difficulties.

Nevertheless, telecommunications planners in the Pacific basin and elsewhere are understandably reluctant to plunge many millions of bgllars into a new satellite system without some promose of a payoff in terms of economic development.

Should they wait for expansion of the telecommunications system to become a virtual necessity for further economic progress, letting it become something of a bottleneck or a constrain? Or should they take a bolder course by building ahead of demand, with the expectation or hope that a reliable telecommunications system would attract economic growth that would not otherwise materialize?

In the remote areas of the Pacific basin, as elsewhere, prompt and dependable availability of financial and other information is an absolute requirement for access to the market economy. Banks, airlines, tourism agencies department stores and financial institutions all require the quality and quantity of information flows that can only be provided by upgraded telecommunications systems. And economic development, conceived of in its most elementary form as a sustained rise in real national income per capita, depends on the expansion of markets and of the market economy. Thus, at least in the Pacific area there seems to be little doubt that improved telecommunications will be vital to continued economic development of the region.

Institutional challenges

A number of structural problems must be addressed if either an interim or a permanent satellite system is to emerge in the Pacific basin:

- INTELSAT must make its concessionary transponder lease rate of $800,000 per year available for Pacific basin traffic, much of which is intraregional, but is technically international;
- INTELSAT must allow carriage of international traffic over non-INTELSAT facilities after 1992, when the dedicated separate system is introduced;
- INMARSAT must be persuaded to allow use of its facilities for shore-to-shore traffic;
- INMARSAT must be convinced to offer a concessionary rate to high-volume users of $1 to $2 per minute;
- Difficult questions about ownership and management of the interim and permanent systems must be addressed. In particular, it is preferable for the permanent system to be owned by the user entities in an economic cooperative arrangement, so their incentives as users and owners balance out, as in INTELSAT;
- A regional focus or headquarters is necessary. Fiji appears well suited for this role because of the ITU and SPEC presence there, as well as its extensive past participation in regional telecommunications questions;
- To encourage participation by French entities in the Pacific basin system, SPEC and the Pacific Forum (the prime ministers in the Pacific region) are the appropriate foci to draw French Polynesia and New Caledonia into the planning process. The ITU also might be helpful in the process, as would diplomatic contacts from other metropolitan powers with interests in the region, such as the United States, Japan, Australia, and New Zealand. □

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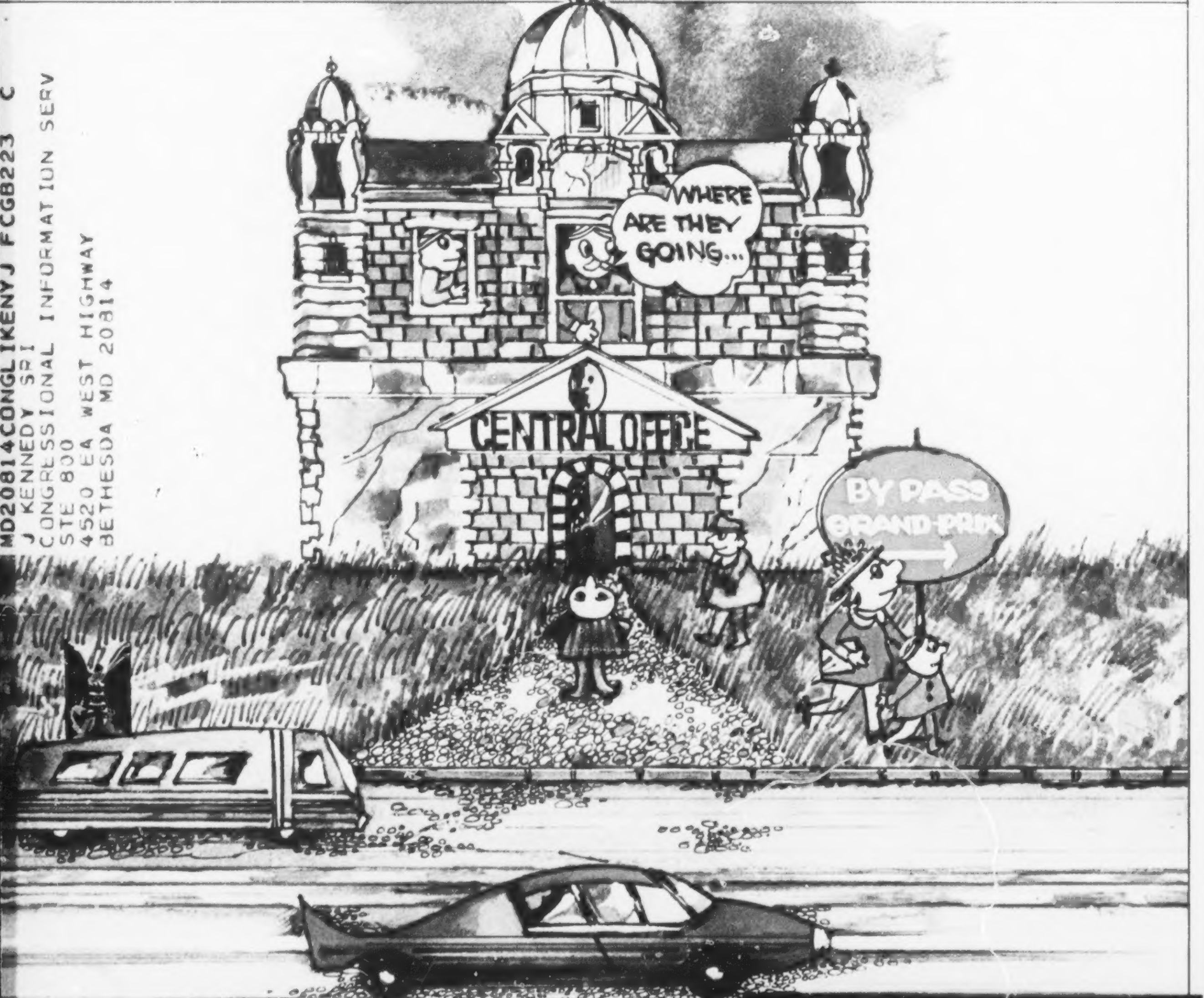

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FO passes by microwave radio for shorter distance uses

Although microwave often is preferred for bypass over longer distances, this comparison of capacity, installation mode and distance reveals that fiber optics can be more cost-efficient over the short-haul

GEORGE M. PFISTER

DURING RECENT RESEARCH, a surprise emerged regarding the superiority of fiber optics (FO) to many other forms of bypass technology. This article compares fiber optics and microwave radio in the 12 GHz (gigahertz) and 18 GHz spectrums under a variety of traffic loading and implementation conditions.

There are three major factors which must be examined. These are distance, capacity and mode of fiber installation.

Fiber optics is distance-sensitive for both the cost of the cable and the cost of installation. Microwave is distance-independent and tends to be most cost-efficient at the utmost limit of its range. At shorter distances, fiber is frequently superior to 12 GHz and 18 GHz radio where circuit groups are large.

Relative to capacity, Perspective Telecommunications Group's research indicates that the usual bypass opportunity must qualify with a minimum of 24 circuits. It should be noted that the scenarios presented here deal with relatively large circuit groups. When fiber is compared to 12 GHz radio, each alternative will be configured in terms of multiplex equipment (which is the only variable cost element per T1 channel) for 672 voice circuits. Similarly, the 18 GHz-fiber optic comparison will be made on the basis of 192 channels.

The most critical factor in comparing microwave and fiber optics is the circumstance of fiber optic installation. Fiber optic cable installed on an aerial basis on existing utility poles costs approximately $5000 per mile to install, while buried cable in an urban environment can cost as much as $50,000 to $100,000 to install. Where fiber can be installed on an aerial basis, it usually will be superior to microwave. Where buried urban or conduit installation is required, the fiber approach only will be superior to 12 GHz radio in the two to five mile range, and always will be inferior to 18 GHz microwave.

While the expense of burying fiber optics at a cost of $50,000 to $100,000 per mile might be a formidable expense to justify, the recurring rental charges for conduit, which in some metropolitan areas run as high as $25,000 per mile per year, would favor the heavy up-front costs for burial of private cable. It is important to examine the actual costs in each area for conduit rental versus burial of private cable, and to adjust the planning calculations according to the actual costs.

Another important consideration is that conduit space rental is not a regulated commodity; rates typically are based on supply and demand. As a result, conduit rental rates will be highest in the most congested areas. In congested areas, the cost of burying cable will come closer to $100,000 per mile. Also, in highly congested areas it may be impossible to obtain the right to dig. In this case, conduit rental may be the only alternative.

In addition to distance, capacity and installation tradeoffs, there are several other factors that should be considered.

As opposed to 2 GHz, which is heavily used by communications carriers, microwave spectrum generally is available in the 12GHz, 18 GHz and 23 GHz bands, even in very congested areas. However, 12 GHz microwave is subject to pre-emption in 1988 by direct broadcast satellite (DBS) and, as such, this implementation could be viewed as short or medium term, about 5 years. The cost of licensing and route surveys is lower as the frequency increases beyond the traditional carrier, or most

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Cover art by Leon Danilovics

Today's telcos will have to adapt to withstand the challenge posed by competitive bypassers.

Table 1
Cost elements of private microwave links

	Operating frequency (GHz)			
	2	12	18	23
Tower (pair)	100	100		
RF + antenna	60	150	70	15
MUX (multiplex)	4	28	8	2
Installation and license	50	25	10	2
Total cost	214	303	88	19
Number of VFs				
Maximum	96	672	192	48
Average	90	300	120	40
Cost/VF	2229	450	458	395

popular, frequency bands (Table 1).

Negotiation of a right-of-way for a fiber optic cable can be relatively simple where only one municipality is involved. Where multiple municipalities are involved, microwave often becomes the automatic choice.

There are two things to remember about right-of-way problems. Many users assume they cannot obtain a right-of-way under any circumstances. However, they can obtain a right-of-way, although it may take as long as 18 months and some legal fees to get on the air.

Those users who can justify a fiber optic cable could simplify the right-of-way situation by working with Western Union, which has extensive right-of-ways in most metropolitan areas.

Also, the topography of the terrain around the user locations must be analyzed to ascertain whether a line of sight exists. In some cases a repeater must be installed for a microwave link, which increases costs to cover the expense of additional radios, multiplex equipment, towers and tower site leasing. Even where a reflector can be used, the substantial cost of a tower ($50,000 to $100,000) could still introduce prohibitive costs.

Weather can limit the range of microwave systems, particularly in the higher frequencies, limiting transmission span distances: 12 GHz microwave can operate out to 12 to 15 miles under most conditions; 18 GHz can operate out to 7 to 10 miles; and 23 GHz can operate over no more than 5 miles.

FO link cost factors

For this research, fiber optics is priced as follows for these subsystems: Cable cost is $5000 per mile for a four-strand fiber (two used, two for protection). Each strand will cost $1000 per mile, and $1000 is allocated to package the strands, yielding the total cost of $5000 per mile. The transmitter cost is $28,000 for both ends of the cable run. The multiplex equipment cost is $1000 per T1 channel, which is identical to the cost for microwave multiplex circuitry. The installation cost will vary depending on the installation situation: aerial installation will be $5000 per mile; conduit will be $5000 to $10,000 per mile; buried (rural or suburban) will be $10,000 to $15,000 per mile; and buried urban will be $50,000 to $100,000 per mile.

Note that the installation of a six-strand system would add an additional $2000 per mile and would double the capacity of the fiber cable.

In this comparison the fiber is to be operated at the DS-3 rate of 44

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Table 2

Aerial installed fiber optics

	Distance (miles)			
	2	5	10	15
Cable cost = $5000/mile	$10,000	$25,000	$50,000	$75,000
Multiplex equipment = $1000/T1	$28,000	$28,000	$28,000	$28,000
Transmitter	$28,000	$28,000	$28,000	$28,000
Installation = $5000/mile	$10,000	$25,000	$50,000	$75,000
Total cost	$68,000	$86,000	$116,000	$146,000
Cost/VF fiber (672 VFs)	$101	$128	$173	$217
12 GHz microwave (672 VFs)				
Total cost	$303,000	$303,000	$303,000	$303,000
Cost/VF	$450	$450	$450	$450
18 GHz microwave (192 VFs)				
Total cost	$88,000	$88,000	$88,000	
Cost//VF	$458	$458	$458	
Fiber (192 VFs)[a]				
Total cost	$48,000	$66,000	$96,000	
Cost/VF	$250	$343	$500	

a. Cost for cable, installation and 8 T1 multiplexers

Table 3

Conduit installed fiber optics

	Distance (miles)			
	2	5	10	15
Cable cost = $5,000/mile	$ 10,000	$ 25,000	$ 50,000	$ 75,000
Multiplex equipment = $1,000/T1	$ 28,000	$ 28,000	$ 28,000	$ 28,000
Transmitter	$ 28,000	$ 28,000	$ 28,000	$ 28,000
Installation = $30,000/mile	$ 60,000	$150,000	$300,000	$450,000
Additional 4 year conduit rental @ $25,000/year	$100,000	$100,000	$100,000	$100,000
Total cost	$226,000	$331,000	$506,000	$681,000
Cost/VF fiber (672 VFs)	$ 336	$ 492	$ 752	$1013
12 GHz microwave (672 VFs)				
Total cost	$303,000	$303,000	$303,000	$303,000
Cost/VF	$ 450	$ 450	$ 450	$ 450
18 GHz microwave (192 VFs)				
Total cost	$ 88,000	$ 88,000	$ 88,000	
Cost/VF	$ 458	$ 458	$ 458	
Fiber (192 VFs)[a]				
Total cost	$206,000	$301,000	$486,000	
Cost/VF	$1073	$1567	$2531	

a. Cost for cable, installation and 8 T1 multiplexers megabits per second (Mbps), and state of the art systems operate at the DS-3C rate of 90 Mbps. Thus, the fiber optic system would have twice the capacity of a 12 GHz microwave.

Aerial installed FO

As shown in Table 2 aerial installed fiber optics is always superior to 12 GHz radio, and is competitive with 18 GHz radio out to ranges where the performance of this radio frequency becomes suspect.

Rental rates for pole space are reasonable, typically about $1 to $2 per pole, per year. The one-time installation cost of $5000 per mile includes these pole rental charges for a 5-year period.

Conduit installed FO

Renting conduit from a local utility allows the user to install a fiber optic cable for approximately $5000 per mile. The cost of installing cable in an existing conduit is comparable to the cost of aerially installed cable, but the rental for the conduit space can be as high as $25,000. As noted in Table 3, an additional cost of $100,000 is included in the fiber optic cost to account for 4 additional years of conduit rental. This annual rental of $25,000 represents an extremely high rate and is used conservatively. In this case, as outlined in Table 3, the fiber optic cable is superior to 12 GHz microwave out to approximately 5 miles. The 18 GHz microwave is always more cost-effective.

Buried urban FO

In the buried urban environment, costs are high because of increased labor costs when pavement must be dug up and restored. In some metropolitan areas the estimated cost of $50,000 per mile could be conservative, $100,000 per mile may be more realistic.

As Table 4 indicates, fiber optics is never superior to 18 GHz radio. Fiber optics' cost advantage over 12 GHz radio disappears where distance exceeds approximately 4.5 miles.

At extended ranges, the distance-independent nature of microwave tends to increase the applicability of this mode of operation. Also, as distance increases to the longer ranges of microwave, the increased probability of having to deal with multiple municipalities for fiber optic right-of-way can introduce difficulties that would make microwave the preferred approach from the outset.

Table 4

Buried urban fiber optics

	Distance (miles) 2	5	10	15
Buried urban				
Cable cost = $5000/mile	$ 10,000	$ 25,000	$ 50,000	$ 75,000
Multiplex equipment = $1000/T1	$ 28,000	$ 28,000	$ 28,000	$ 28,000
Transmitter	$ 28,000	$ 28,000	$ 28,000	$ 28,000
Installation = $50,000/mile	$100,000	$250,000	$500,000	$750,000
Total cost	$166,000	$331,000	$606,000	$1,616,000
Cost/VF fiber (672 VFs)	$ 247	$ 492	$ 901	$2404
12 GHz microwave (672 VFs)				
Total cost	$303,000	$303,000	$303,000	$303,000
Cost/VF	$ 450	$ 450	$ 450	$ 450
18 GHz microwave (192 VFs)				
Total cost	$ 88,000	$ 88,000	$ 88,000	
Cost/VF	$ 458	$ 458	$ 458	
Fiber (192/VFs)[a]				
Total cost	$146,000	$311,000	$586,000	
Cost/VF	$ 760	$1619	$3052	

a. Cost for cable, installation and 8 T1 Multiplexers

Fiber optic cable is the preferred approach for very high capacity links because it has twice the circuit capacity of 12 GHz radio if implemented on a DS-3C (90 Mbps) signaling rate. Comparing fiber and 18 GHz radio, the capacity advantage of the fiber is even more impressive, offering 672 voice frequencies (VFs), compared to 192 VFs at DS-3 rates.

As can be seen in Table 5, the aerial installed fiber optics is superior to 18 GHz microwave out to 8 or 9 miles, at which point the consistent performance of the radio approach under adverse weather conditions could be suspect. However, where buried urban or conduit installation is required for a fiber link, it will be one and one-half to six times as expensive as 18 GHz radio.

All of the alternatives presented here assume complete loading of either the fiber or microwave systems, and it is likely that few users can anticipate bypass or private networks which require 192 or 672 voice circuits.

One might ask whether this analysis is an academic exercise.

The answer is that high levels of capacity can be required for several reasons.

The requirements for high-speed data channels operating at T1 rates of 1.544 Mbps or higher could have significant impact by absorbing channels on the lower capacity 18 GHz microwave.

Also, some users are implementing or planning short-haul video teleconferencing systems. While great strides are being made for compres-

Continued on page 45

Table 5

Fiber optics vs. 18 GHz microwave

18 GHz radio	$ 458	$ 458	$ 458
Aerial fiber	$ 250	$ 343	$ 500
Conduit fiber	$1073	$1567	$2531
Buried urban fiber	$ 760	$1619	$3052

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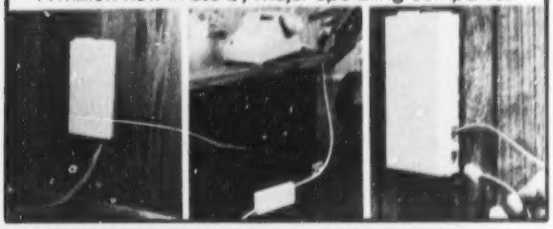

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sion of digital video into the 1.544 Mbps range, video codecs operating at 3.0 or 6.0 Mbps transmission rates may be required which would have severe impact on an 18 GHz microwave system.

An additional capacity consideration in favor of fiber optics is raised by the possible resale of bandwidth to another user whose route is complementary to the one being contemplated.

Also, remember that the typical bypass requirement will be in the 24 to 48 circuit range which can be adequately handled by 23 GHz microwave systems, such as General Electric's Gemlink. At a total cost of $19,000, these systems will be very attractive where the 5 mile distance constraint is not an issue.

Users who are contemplating a private network to support requirements which exceed the current capabilities of the telco twisted pair plant, such as 56 kilobits per second (kbps) or 1.544 Mbps rates should also be patient. Technologies such as terrestrial data circuits (TDC), effectively a T1 carrier, and circuit switched digital capability (CSDC), which allows alternate 64 kbps pulse code modulation (PCM) voice or 56 kbps data, will be appearing in the next few years. Therefore, a private network justified because of the unavailability of broadband data might be suspect with these new services in the offing.

Further, it is estimated that 5% of the existing local access plant is being upgraded to digital T1 based technology on an annual basis. One major communications manufacturer suggests that 40% of many major metropolitan areas are already wired this way. As a result, derivation of TDC and CSDC channels can be expected to alleviate today's bottlenecks in about 5 years.

As a result of competition and digital plant, it is expected that costs for broadband digital circuits will decrease dramatically in the years ahead.

Also, while few users can justify communications links with 192 to 672 voice channels, the local telco frequently can justify such links. The local telcos can be expected to make maximum use of fiber optics, and they own conduit and right-of-ways—the infrastructure to support broadband services at cost-effective rates. In other words, current deficiencies in service availability should not be assumed for the long term. □

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Section analysis: a cost-effective approach to cable maintenance

Section analysis is a disciplined, methodical system for troubleshooting and recovering faulted cable pairs. While it is not always the fastest approach, it usually is the most cost-effective solution

DON McCARTY

SECTION ANALYSIS is a disciplined, methodical system for troubleshooting and recovering faulted cable pairs. Though it's not always the fastest approach to service restoration, in the short term it can be the most cost effective by far, as well as actually taking the least labor hours in the long run.

In most operating companies today, the average cable repair technician sees his or her first duty as being to restore service as quickly as possible. A number of inventive short-cuts to speedy restoration have been discovered—most of them at the expense of efficient outside plant maintenance and operation. A faulted pair not repaired is a pair lost to service, and a trouble not located and fixed will invariably spread to adjacent pairs and cause repeat calls and more repeat calls for the same basic trouble.

With section analysis, however, the basic trouble is analyzed and repaired at first report. The net result is that more pairs are maintained available for present or future service, and the trouble doesn't have the chance to spread to adjacent pairs, so the costs of repeat service calls or unnecessary cable route reinforcement are avoided.

Achieving this, of course, demands a commitment to the section analysis concept. That includes providing cable repair personnel with the knowledge and the tools to do the job, and emphasizing to them the change in troubleshooting philosophy it entails.

With proper management support, a well-trained and properly equipped cable repair technician can isolate a trouble section, analyze the type of trouble and the probable cause, and get to the problem quickly to effect a permanent repair.

The tools it takes

The right tools speed analysis and location. A section analysis package offered by Dynatel includes three complementary cable fault locating instruments that indicate conditions in a cable section and guide the technician to the point at which corrective action is required. The devices are a resistance fault locator, an open (or open and split) locator, and a cable and sheath fault locator.

The resistance fault locators measure metallic-type faults as high as 1.5 million ohms. They test and analyze cable conditions and locate faults to a distance of 100,000 ft. (approximately 18 miles). Shorts, grounds, crosses and cross-battery also can be located.

The first steps in section analysis are performed with a resistance fault locator. It tests cable, analyzes the type and extent of troubles and displays the distance to a faulted section.

Once primary testing and location are done and the trouble section defined, a capacitance bridge can be used to analyze and locate opens in the section. Used with the resistance fault locator, the capacitance bridge will reveal any water that may have entered the sheath.

With the trouble section determined, the exact route and distance between accesses must be deter-

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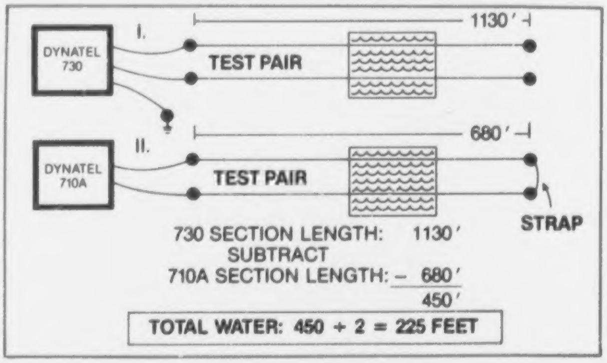
FIG. 1 *Diagram shows how to measure the amount of water in a cable.*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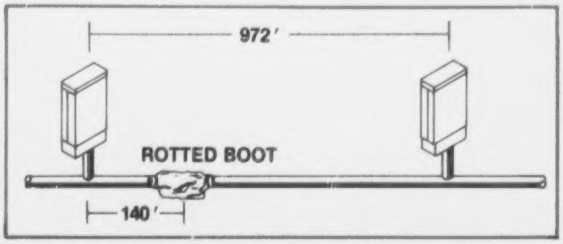

FIG. 2 *Diagram illustrates how rotted boot exposes the conductors to moisture.*

Don McCarty is Product Sales Manager in the Dynatel Dept. of the Telcomm Products Div./3M, Sunnyvale, Calif. This article has been adapted from a report published by Dynatel Dept., Telcomm Products Div./3M. Copyright Minnesota Mining & Mfg. Co. 1982.

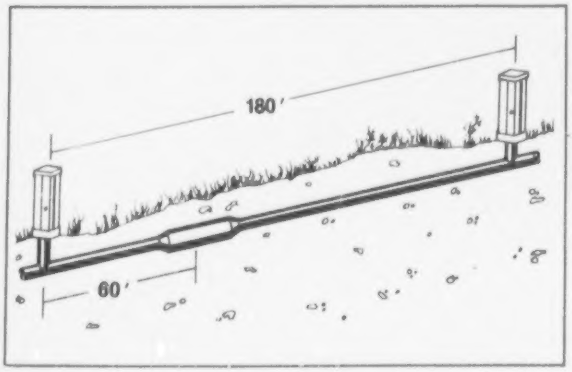

FIG. 3 *At this installation a* VOM *indicated a sheath fault. The capacitive length is 260 ft. and the correct resistive length is 180 ft. Conductor faults were indicated 60 ft. from the hookup.*

mined for accurate location measurements. A cable and sheath fault locator will allow the cable path to be accurately marked and measured. Characteristics such as slack-loops and butt splices can be identified so that exact distances can be determined. When a cable and sheath fault locator indicates a sheath fault in the test section, an earth frame guides the technician to the fault site.

The importance of training

No equipment is any good unless the cable repair technician knows how to use it. Part of the support maintenance personnel need from their operating companies is thorough training, not only in the use of individual test equipment, but also in the use of all their equipment as an interrelated cable analysis system. Several test equipment manufacturers have customer training programs that will help achieve this.

But there's more to it than equipment and training. A management commitment to section analysis is necessary, and that commitment has to be instilled in the craftspeople who will carry it out.

Suppose the technician dispatched on a subscriber complaint finds the pair defective between the "work-out" terminal and the field. It tests OK back to the central office. The quick fix here is to "cobb" the pairs, or simply cut them off to the field. The subscriber's happy—service has been restored. The repair technician's happy—it took only a few minutes. The supervisor's happy—work can begin on the next case.

But the outside plant is a potential disaster. That trouble has been circumvented for one subscriber, but its cause is still somewhere out in the field. Whatever it may be—water, a cable nick, a defective splice—it's still there, and it's going to be heard from again.

Or suppose the subscriber pair is found to be faulted back toward the central office. The common solution is to cut to clear, changing over to a new pair.

The customer's back in service and the job is done. But the trouble's not repaired.

Or the pair can be transposed, or "rolled," if a trouble section can be isolated and a good pair through it is attached to the subscriber pair at both ends. Once more, the customer's back in service and the trouble's still there.

There's a limit to how long this sort of thing can go on before the route runs out of spare pairs and reinforcement becomes necessary. That's expensive—and often unnecessary where good maintenance and recovery practices keep things working.

Now, let's look at how section analysis would be applied in this same case of trouble.

First, the technician must isolate the trouble section. In order to find a pair that goes around the trouble—or to be able to run a separate good pair if necessary—the trouble has to be isolated between accesses. There the true analysis can begin.

Next, the technician must develop a physical and conceptual picture of the cable before doing any digging or opening. Look at the situation. Is the section level or running up or downhill? Are there signs of recent construction work or digging in the cable path? What kind of cable and pair count is involved? And before going too far, the length, gauge and temperature should be accurately determined, either by maps or direct location and measurement.

The technician should use maps or sequential markings on the cable. If this information is unsatisfactory, he must locate the cable path and measure the length with a wheel or tape.

Some possibilities and expectations should be apparent already. If there is water in the cable, it would tend to collect on the downhill side. If a recent dig has taken place near the path, that's a logical place to suspect a nick.

A solid understanding of cable makeup is an invaluable tool in section analysis. The cable is manufactured for good transmission characteristics, but analysis of changes in these characteristics are the primary clues to why a cable has failed.

For example, an average exchange cable, either air core or filled, will be all one gauge. Any gauge substitution will measure a different electrical footage over its physical length. A total of 900 ft. of 24 gauge with 200 ft. of 22 gauge substituted will measure 825 with a bridge. Analysis of this occurrence also indicates 2 splices in the section.

The average mutual capacitance of an air core cable is .083 microfarads per mile. Any intrusion of water will increase the capacitance, and make the cable appear longer than the actual physical length of the section.

Once the physical distance of the section has been determined, the first step is to measure the distance with a resistance fault locator. Any subtle difference between this measurement and the actual length indicates a gauge change. If the physical distance is the same, measure the capacitive distance with the capacitance bridges. This will indicate any amount of water in the cable.

Battery on the shield means a portion of the section needs to be purged or replaced. Any shealth faults can be identified with a device designed for that purpose.

The next test is to establish the extent the dielectric integrity of the cable has been violated. For this, a resistance bridge is the first test instrument used on the section.

Using the bridge, the technician can analyze the troubles in the test section. A pattern of symptoms will emerge and help identify the type of trouble.

For instance, if several light faults, mostly ring-battery crosses with the tips clear, are detected, there's water in the cable.

If several high-resistance troubles with shorts, crosses and grounds on both tip and ring—and some opens—are detected, water again is indicated—but this time it's probably in a splice or encapsulation.

And both light and solid troubles with many shorts and opens would indicate cable damage.

To check the integrity of the sheath the technician removes the

Continued on page 76

Table 1

Cost to replace 972 ft. of cable:

Cable	$ 6306.34
Splices (2 @ $1404.00 each)	2808.00
Placing	1633.00
Total	$10,747.34

Cost of repair on splice:

Splice	$1404.00
Pit	500.00
Total	$1904.00

Savings:

Cost of replacement	$10,747.34
Cost of splice repair	1904.00
Savings	$ 8,843.34

bonds at both ends of the section and test with a voltmeter. If there is an indication of battery on the shield—5 or more volts dc from faulted rings—it is intact and there is no damage. If the sheath were damaged and grounded, this battery would drain to ground and not show on the meter. Therefore, the trouble is due to water. The alternatives are limited to farming the cable, purging, or replacing the section.

To determine the extent of water in the cable, the distance-to-strap on a good pair in the section should be measured. This distance should agree with the known physical distance. But what if it does not?

There may be a gauge change in the section. If there is a gauge change, the splice may very possibly be the site of the trouble.

Next the section length should be tested with a capacitance bridge. If the distance measured agrees with the first reading, no water is in the cable, or it's at least confined to a very small section such as a splice. Since water drastically affects cable capacitance, a longer reading on the capacitance bridge indicates water. For example, if the distance-to-strap reading is 700 ft. and the capacitance bridge indicates a length of 1100 ft., there is 400 ft. too much capacitance in the section. Divide this figure by two for an approximate of the amount of water (Figure 1).

Now resistance faults on the conductors can be analyzed and located. The technician should shoot the trouble pairs and note the locations. If the faults appear to be randomly distributed over a length of cable, a length or "slug" of water in the cable at some location other than a splice or encapsulation is indicated.

If the faults appear to be grouped at one or two locations, it is likely there is trouble in a splice or encapsulation.

If the faults are all grouped in one location, with opens indicated, physical damage to the cable is indicated.

When the integrity of the cable sheath is violated, battery will leak to ground at the site of the damage. An earth-gradient device will accurately locate the fault. The entire path of the trouble section should be located because there might be more than one fault.

Once these steps are complete—and it pays to take notes on findings—an accurate picture of the section's condition will emerge.

Representative results

Now that we've seen how section analysis is performed, let's look at a few real-life case histories to see how it's been used and what it's actually been able to achieve.

One case occurred in a section of 900-pair PIC (polyethylene insulated cable) in New Mexico. The section was already up for replacement. Testing showed the faults were grounds, shorts with cross-battery and tips going open. Since no battery was indicated on the shield, a splice failure was suspected.

A test with a resistance fault locator confirmed the physical distance of the section by taking a distance-to-strap reading on a shorted pair. The distance read was 972 ft. with the resistance faults 140 ft. from the pedestal. A capacitance bridge was used to confirm the section distance—showing 980 ft., or no intrusion of water—and a cable and sheath fault locator confirmed shield damage at 140 ft. from the pedestal.

Excavation exposed a splice failure—a boot on the cable had rotted away, exposing the conductors to moisture (Figure 2).

Here's how the procedure helped save money. The estimated cost of replacing the section—$6306.34 for the cable, $2808.00 for splices and $1633.00 for cable placement—came to $10,747.34.

In comparison, repairing the failed splice cost $1404.00 for the repair and $500 for the excavation for a total cost of $1904.00.

That's a savings of $8843.34 over the anticipated, but unnecessary, cost of replacement (Table 1).

Another example occurred in a 180-ft. section of 50 pair, 24 gauge PIC in California. Tests showed grounded shorts, cross-battery, open tips, and no battery on the sheath. The bonds were removed and a VOM (volt-ohm meter) indicated a 150-ohm sheath fault.

A capacitance-resistance comparison was run, and showed a capacitive length of 260 ft. and a correct resistive length of 180 ft. Dividing the difference—80 ft.—by two indicated that there was 40 ft. of water in the section.

Conductor faults were indicated 60 ft. from the hookup. Excavation revealed a bad encapsulated splice at that location. After shorting a pair in each direction, the readings agreed on a distance of 120 ft. out from the original hookup. Shooting back, the resistive measurement was 60 ft., and the capacitive was 120 ft. The water was in that shorter section (Figure 3).

In this case, the operating company saved by installing one-third as much cable as it had first thought necessary. Initially, it had planned to replace the whole section, at a cable cost of $102.60, $293.76 for placing it, $332 for splices, and $500 for the pit work, at a total cost of $1228.36.

The 60-ft. section found to actually be necessary after section analysis, however, cost $34.32, and $97.92 to place. The entire job was done for $964.24 (Table 2).

Another example occurred in Colorado. Section analysis was used on a 450-ft. section of 100 pair, 24 gauge PIC, and showed a complete cable failure: all pairs were faulted to ground and shorted. When the shield was isolated, a VOM showed a shield fault of 4500 ohms.

The capacitance bridge showed a

Continued on page 80

Table 2

Cost of replacing 180 ft. of cable:

Cable	$ 102.60
Placing	293.76
Splices	332.00
Pit	500.00
Total	$1228.36

Cost of replacing 60 ft. of cable:

Cable	$ 34.32
Placing	97.92
Splices	332.00
Pit	500.00
Total	$964.24

Savings:

Replacing 180 ft. of cable	$1228.36
Replacing 60 ft. of cable	964.24
Savings	$ 264.12

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Table 3

Cost of replacing 450 ft. of cable:

Cable	$ 411.75
Placing	734.00
Splices (2 @ $241.00 each)	482.00
Pits (2 @ $500.00 each)	1000.00
Total	**$2627.75**

Cost of replacing 70 ft. of cable:

Cable	$ 68.62
Placing	122.00
Splices (2 @ $241.00 each)	482.00
Pits (2 @ $500.00 each)	1000.00
Total	$1672.62

Savings:

Replacing 450 ft. of cable	$2627.75
Replacing 70 ft. of cable	1672.62
Savings	$ 955.13

cable length of 600 ft., and the resistance fault locator read the actual length. Again, dividing the difference by two indicated that there was about 75 ft. of water in the section.

Conductor faults measured 70 ft. from the test hookup, and the distance was confirmed. Excavation revealed a water-filled lead sleeve.

The cable was opened and readings were taken in both directions. In readings taken to the strap, the capacitance and resistance readings agreed at the actual length of 380 ft. Back to the first hookup site, though, the resistive reading was 70 ft. and the capacitive reading was 220 ft. That was the wet section, and the only part of the cable in need of replacement.

Here's the cost comparison: replacing all 450 ft. of the section would have cost $411.75 for cable, $734.00 for placing it, $482.00 for splices, and $1000 for pit digging—all at a total of $2627.75.

Replacing the 70 ft. wet section, though, cost $68.82 for the cable, $122.00 for placement, and the same $1482 for splices and digging, for a total of $1672.52. That's a savings of $995.13, or over 36% (Table 3).

In each case the section analysis procedure adds cost over less thorough fault finding techniques—but the amount is not as much as the cost being saved.

And in cases such as the hypothetical example given earlier, bearing a little more cost for troubleshooting and repair up front saves the cost of further cable deterioration, subscriber complaints, and repeat service calls. ☐

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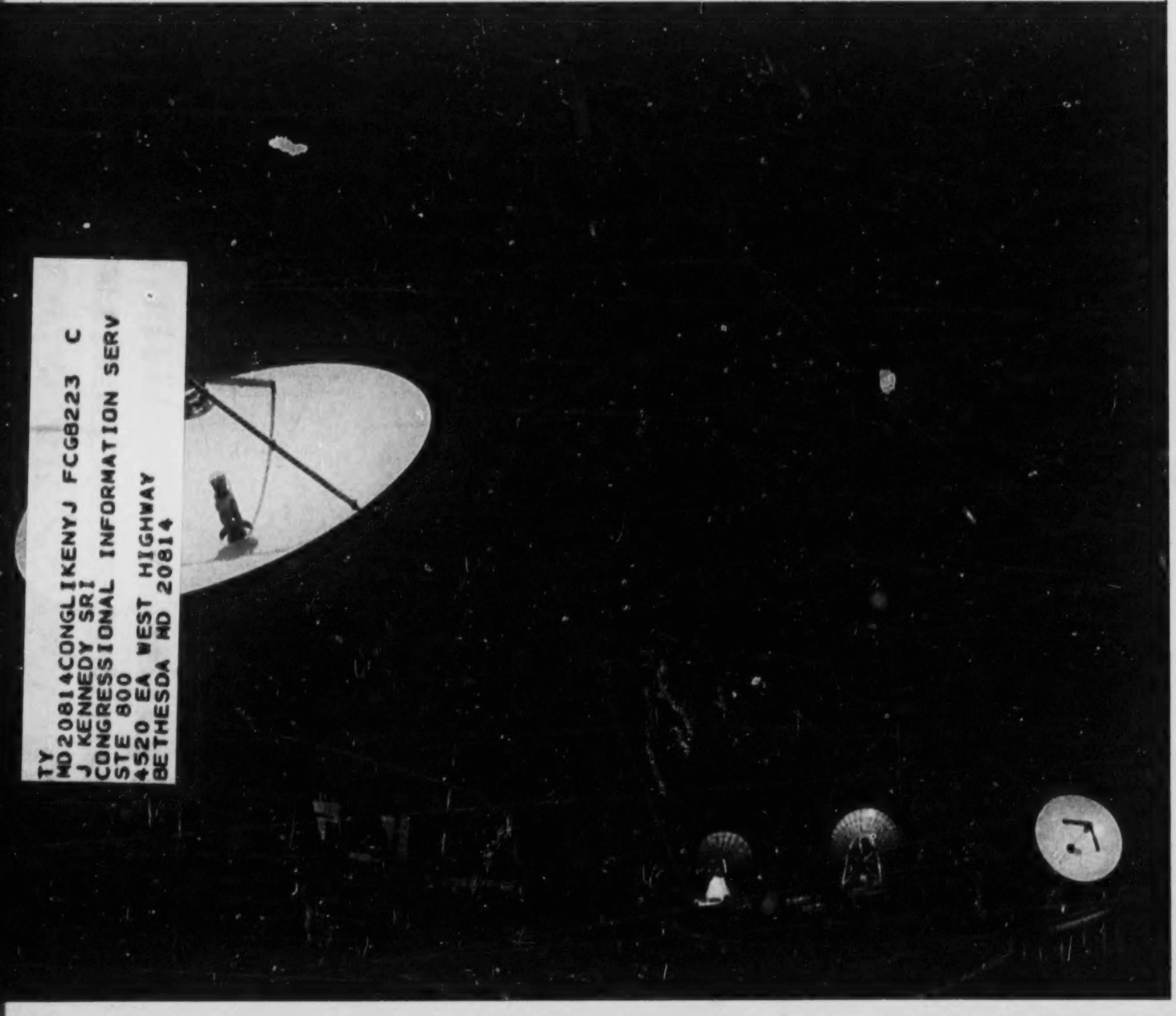

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Telecommunications is expanding this gateway to China

Hong Kong has become a major hub of international communications. Here is a close-up view of the company which connects Southeast Asia with the rest of the world

PETER FORESTAL

HONG KONG'S NAME is derived from the Chinese words for "fragrant harbor." Its natural deep water harbor at the estuary of the Pearl River has brought prosperity to Hong Kong.

Hong Kong became a British colony in 1842 and by 1873 John Pender, a wealthy English businessman and founder of submarine telegraph companies, had formed the Eastern Extension Australasia and China Telegraph Co., which linked Hong Kong by submarine telegraph cable to Madras, Darwin, Singapore, Saigon and Shanghai. This company was the grandparent company of Cable and Wireless (Hong Kong) Ltd. (CWHK), and even today the Cantonese name for CWHK is Dai Dung Din Bo Ko, or Great Eastern Telegraph Bureau.

In the 141 years since Hong Kong became a colony, it has become the third largest container port in the world and the third largest gold dealing center in the world. The population is now 5.5 million.

CWHK provides all the international telecommunications and some internal services for Hong Kong. CWHK now has direct links with 46 countries and has become a major transit center for telephone, telex and data traffic in Southeast Asia.

The company was established as a separate entity from the London office on Oct. 1, 1981. Currently, 20% of the shares are held by the Hong Kong government and 80% are held by Cable and Wireless plc (CWPLC) of the U.K.

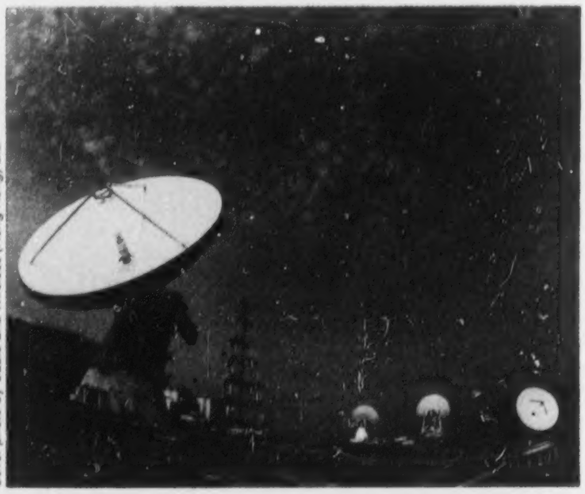
The executive committee headed by Managing Director Brian Pemberton reports to the board of directors. There are five general managers and a senior general manager on the committee. There are six business functions in CWHK, each one headed by one of the general managers on the executive committee. They are personnel and administration, local engineering, international engineering, telecommunications services and marketing, and finance.

The continuous expansion of telecommunications in Hong Kong caused the company to outgrow its offices in Mercury House, on Hong Kong Island. A 21-story building, named New Mercury House, was built on land reclaimed from the harbor in 1972, and was officially opened in January 1973.

Further expansion resulted in construction of another telecommunications center on the mainland. A new 12-story building, Hermes House in Kowloon, was completed in 1981, across the harbor from New Mercury House. Hermes House will provide for even diversification of both telephone and telex facilities, and allow for restoration if an accident damages one of the facilities in either building. The telex service already has been fully diversified. Telephone service diversification will be completed in November.

As part of the expansion program, the acquisition last March by Cable and Wireless plc of the 34.8% controlling interest in Hong Kong Telephone Co. will provide an increasingly close cooperation between Cable and Wireless and Hong Kong Telephone Co. This will enable Hong Kong to continue to strengthen its position as one of the world's major communications centers. Hong Kong Telephone Co. has more than 2 million telephones installed. In January 1982, 64.1% of international outgoing calls were subscriber dialed. All urban and interurban telephone calls are free. Hong Kong Telephone Co. is increasing the local line capacity by the use of optical fiber cables and pulse code modulation (PCM).

CWHK currently has more than 2700 employes. The company runs a technical and operating school with instructors who can speak Mandarin, Cantonese and English. About 12 basic technician courses are con-



The four CWHK satellite dishes located at Stanley, Hong Kong.

Cover photo by Cable and Wireless (Hong Kong) Ltd.

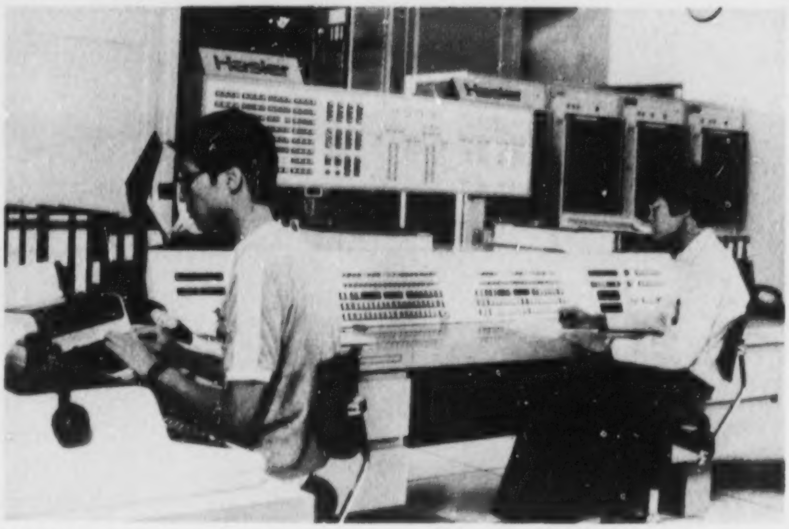
Peter Forestal is General Manager International Engineering at Cable and Wireless (Hong Kong) Ltd., Hong Kong.

ducted each year. In 1981-82, 440 staff members participated in a variety of in-house training programs.

The company's Local Engineering group deals with the technical areas within Hong Kong, which include more than solely telecommunications. The group handles:

- Installation and maintenance of radar, navigational aids and various telecommunications facilities associated with the Hong Kong International Airport.
- Engineering services and studio control for the government-owned Radio Television Hong Kong.
- Sound systems in city halls, computer controlled score boards and the Space Museum's Planetarium.

This functional area also covers the increasing new business with China. In perhaps over-simplified terms, CWHK views telecommunications development with China as its largest potential growth area. (See Figure 1 for telephone traffic volumes between Hong Kong and China.) Current statistics show that China is the fifth largest market for international telephone calls out of Hong Kong (Figure 2). That situation will soon change if predictions from CWHK engineers are fulfilled. On March 17, 1981, an agreement was signed in Guangzhou in China, between the Guangdong Posts and Telecommunications Bureau (GPTB) and CWHK for an HK$32 million (approximately $4.3 million U.S.) microwave link to expand the route from South China to Hong Kong. This new 2700 channel system will link Hong Kong to Shenzhen and Guangzhou, and is supplementary to an existing land coaxial cable system that was installed in 1974 carrying 300 channels. Saturation of the cable route is due to be reached next year and the new microwave system's capacity is planned for a 10-year life.


CWHK's second automatic telex exchange was installed at Hermes House in Kowloon in 1981.

Heading the CWHK China project team for the microwave link is Fung Hak Ming, general manager of Local Engineering. The system will have a main link, tail links, repeater stations and a land coaxial element. Link tests are scheduled to be performed in early August. The system is expected to be ready for service by the end of August.

The Hong Kong-Guangzhou link will feed telecommunications traffic into a planned microwave system that will eventually stretch 975 kilometers and span the entire province of Guangdong. This 25-hop system, designed to handle up to 2700 channels, will link Hong Kong, Shenzhen, Zhuhai, Dongguan and Guangzhou. The first phase of this microwave system, which is due to be completed in 1984, will connect Haikou on Hainan Island with Guangzhou. The link to Shantou, which will complete the system, is planned to be ready for service the following year. The system will be capable of carrying 960 telephone conversations simultaneously, as well as full-color television program signals. There will be automatic protection against failure; reliability will be further improved by the use of energy-saving solar power generators at repeater stations.

The message switching in New Mercury House handles more than 5 million messages per month.

Another area of interest with China is the oil exploration business in which Cable and Wireless plc is providing the telecomunications links with China's offshore oil rigs.

The International Engineering group is responsible for international outlets, back-hauls and interstation links. It plans, installs and maintains the satellite earth station, submarine telephone cable station, microwave, tropospheric scatter, VHF/UHF (very high frequency/ultra-high frequency), HF (high frequency band) radio, ship-shore station, IMCs (international maintenance centers), ISTCs (integrated switching and testing centers) and international telephone switching centers.

When the first antenna at the satellite earth station was brought into service in 1969, it had only 22 channels. This year there are four 30-meter

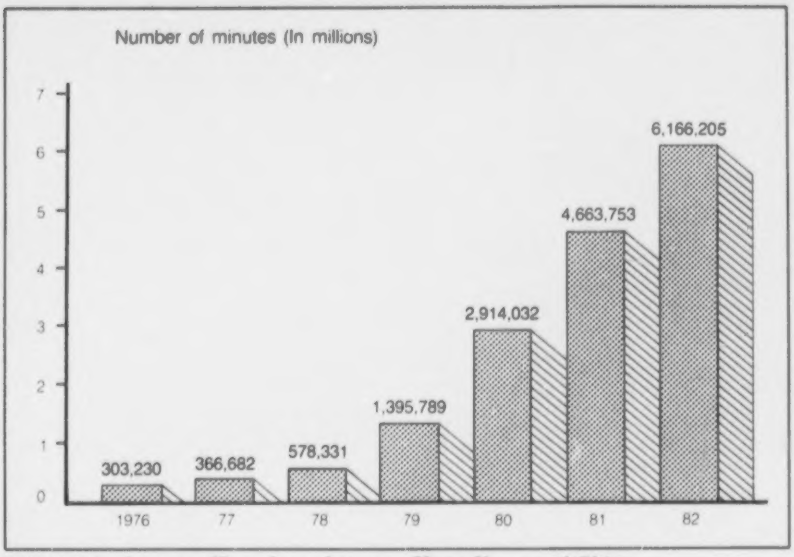


FIG. 1 *Telephone traffic volume between Hong Kong and China.*

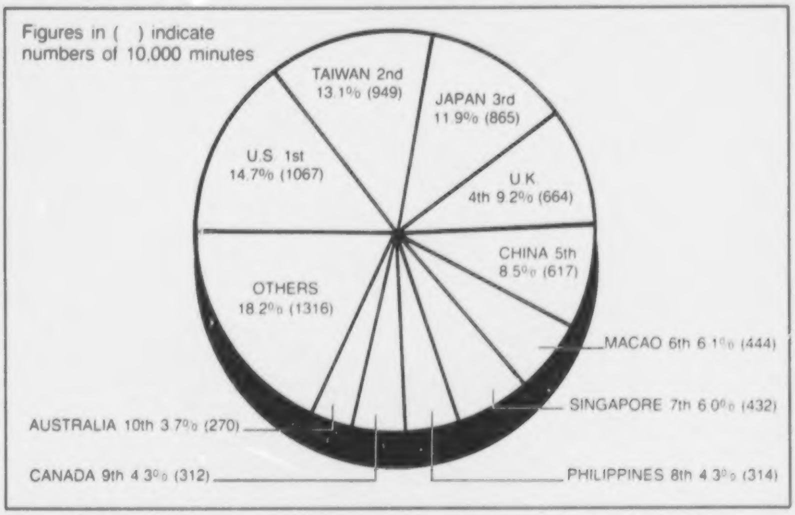


FIG. 2 *Top 10 destinations for international telephone calls during 1982.*

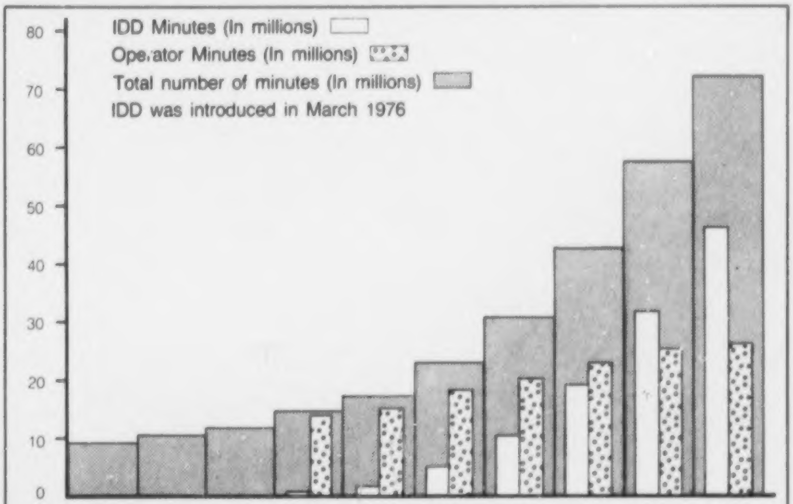


FIG. 3 *International telephone calls from Hong Kong.*

antennas at the earth station using over 1000 satellite channels. One of these will replace the 1969 antenna. There are 28 countries connected with Hong Kong via the Indian Ocean satellite and 19 connected via the Pacific Ocean satellite. To take advantage of the INTELSAT V (International Telecommunications Satellite consortium) digital system, the earth station is being supplied with time division multiple access/digital speech interpolation (TDMA/DSI) equipment, to cope with further expansion through the Indian Ocean satellite. Since reliability is important, the new earth stations are designed to withstand severe weather conditions, such as the typhoon conditions which are common in the area. The two new 30-meter diameter dish-shaped aerials are designed to remain operational in wind speeds up to 118 mph (miles per hour) and survive wind speeds up to 210 mph.

There are three submarine coaxial telephone cables radiating from the deep water bay coaxial cable terminal: SEACOM B (Southeast Asia Commonwealth Submarine Cable System) to Singapore via Kota Kinabulu, SEACOM F to Australia via Guam and OLUHO (Hong Kong-Okinawa-Philippines cable system) to Japan via Currimao in the Philippines. It has been proposed to increase the capacity of SEACOM using circuit multiplying equipment (CME) similar to time assignment speech interpolation (TASI).

In December 1982, an agreement was signed in Taipei between the Telecommunications Authority of Singapore, CWHK and the International Telecommunications Development Corp. of Taiwan to construct a submarine cable system linking Singapore, Hong Kong and Taiwan (SIN-HON-TAI). The section of the submarine cable between Hong Kong and Taiwan is designed to replace the existing Hong Kong-Taiwan tropospheric-scatter system which, after 15 years of service, will be discarded. The new cable system will further diversify connections to overseas countries and interconnect with submarine cable systems in the Pacific region.

It also will have access to the Assn. of Southeast Asian Nations (ASEAN) submarine cable network through Singapore, interconnect with the proposed cable system across the Indian Ocean to Europe, and link up with the planned cable route to Indonesia and Australia. The SIN-HON-TAI cable sys-

Continued on page 40

tem is expected to be ready for service toward the end of 1985.

The first working optical fiber cable system in Hong Kong was installed by CWHK between Hermes House and New Mercury House in 1981. It was used to connect 8000 telex subscribers from Kowloon to the automatic telex exchange (ATX) in New Mercury House before the Hermes House ATX was put into service in May 1982. It is used now to provide inter-ATX junctions and inter-ITSC (International Telephone Switching Center) circuits between the two buildings.

Two optical fiber cables are used, one through the cross harbor road tunnel and the other through the cross harbor underground railway tunnel. There also is a comprehensive coaxial cable and microwave system to link Hermes House into the back-haul hypergroup network from the earth station and submarine cable terminal. New Mercury House also forms a node in the back-haul network; it is possible to reroute traffic around the system if any section of the network is affected by typhoon damage or interference.

The international telephone service is jointly provided by CWHK, which has responsibility for international switching and overseas connections, and Hong Kong Telephone Co., which provides the local telephone network and operator assistance. International phone calls provide one measure of the traffic increase. International telephone calls from the territory represented 5.3 million minutes in 1971, rising to 14.5 million minutes in 1976 and 57.8 million minutes in 1981. Figures for 1982 show a 20% increase over 1981 (Figure 3). At the present time, all the international telephone calls are switched by a stored program control (SPC) exchange manufactured by Ericsson, in the International Telephone Switching Center, in New Mercury House. This exchange was installed in 1972 and has been expanded to be equipped for 1360 C5 signaling and 900 C6 signaling international circuits. It is capable of handling 31,600 calls per hour. The new ITSC being installed in Hermes House this year is also an SPC exchange. It is an Ericsson digital switching system with ultimate capacity for 60,000 channels. Initially, it will be equipped for a total of 2920 international circuits and will be capable of handling 39,000 call attempts per hour.

The company's Telecommunications Services and Marketing group covers customer services and marketing. Its telex subgroup includes the provision of the two SPC automatic telex exchanges in Hong Kong. The exchanges are computer controlled and manufactured by Hasler of Switzerland. Each has an initial capacity of 15,000 lines, with the New Mercury House switch now providing 9900 telex subscribers and the Hermes House providing 9200 telex subscribers. The ultimate capacity of each exchange is 32,000 telex subscribers. A standard feature of the Hong Kong telex service is the capacity to store and forward outgoing telex messages if telecomunication lines are busy. The subscriber is subsequently notified by telex when the message is finally forwarded.

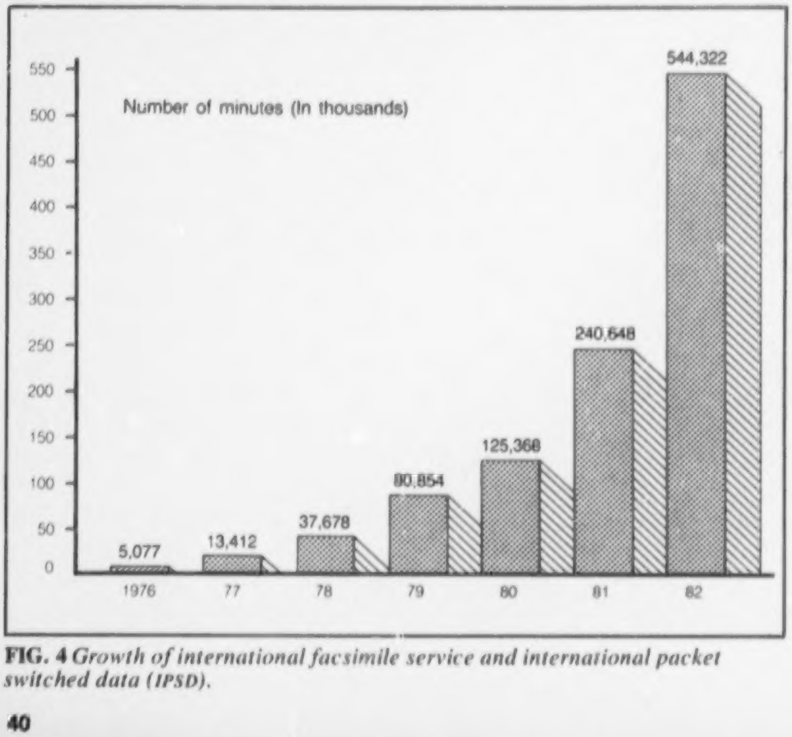


FIG. 4 *Growth of international facsimile service and international packet switched data (IPSD).*

The message switching subgroup also is expanding its operations. A large computer message switch for the use of private customer networks has just been commissioned. This is the Vanguard system, designed and installed by Cable and Wireless. The message switching center (MSC) has expanded rapidly since starting up in 1969. It is now the largest real time switching center in Asia and the Far East, handling over 5 million messages per month at a peak output rate of 38,000 messages per hour. The new Univac 1100/62 system for Vanguard is planned to replace all the current Univac 418/II and 418/III systems that cater for 150 subscribers and almost 2000 leased circuits and, at the same time, to provide for expansion to meet increased demand with enhanced facilities.

Many private customer data networks are hubbed from equipment in New Mercury House and an international public packet switched data network which is available through IDAS (International Database Access Service). Hong Kong IDAS subscribers can connect with data subscribers of Tymnet and Telenet networks in the U.S., Datapac in Canada, International Packet Switched Service (IPSS) in the U.K. and Radio Suisse network in Switzerland.

A high-speed facsimile (FAX) service is available to 25 countries through the Bureaufax system. FAX services, as measured by usage, have grown increasingly popular.

Future developments include an electronic mail facility and teletex. Teletex is designed to provide international high-speed data transfer between teleprinter terminals that can communicate automatically, computer to computer, using the internationally accepted CCITT (International Telegraph & Telephone Consultative Committee) teletex standard. Unlike telex, it will not be limited to one network but will be able to use the packet switched network, the public telephone network and the current worldwide telex network. Electronic mail is expected to be launched as a CWHK service in Hong Kong this year, as part of general office automation. □

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North American installations of time division digital switches

AMOS E. JOEL JR.

When Amos Joel Jr. retired from a switching career that spanned more than 42 years at Bell Telephone Laboratories, inaction did not set in. He currently is serving AT&T International as an executive consultant, planning a special issue of the IEEE (Institution of Electrical and Electronic Engineers) Transactions on "Telecommunications Switching Technology to Serve Business" (see page 31) and planning to journey to Geneva, Switzerland, in October to receive the International Telecommunication Union's 2nd Centenary Prize during Telecom 83 (TELEPHONY, July 25, p. 88). Meanwhile, he has updated his periodic survey of North American time division switching installations (TELEPHONY, June 21, 1982, p. 32). The results, through December 1982, are presented here.—*Editor*

North American time division digital switching (1982)

System(s)	ITT/North 1210	No. 3 EAX	No. 5 EAX	NEAX 61	DCO	DMS 10	DMS 100/200/300	ITS 4/5	No. 4 ESS	No. 5 ESS	Totals
1. Base units in service YE 82											
a) Total	163	36	10	78	292	612	263	183	90	2	1729
b) Class 5	111		10	63	286	597	148	125		2	1342
c) Class 4/5	42			13	5	14	67	41			182
d) Class 4	10	36		2	1	1	27	17	90		184
e) Other							21				21
2. Number of remote switching units in service YE 82											
On base units	75			49	141	145	248	319			977
3. Number of total lines in service YE 82	573K		25K	323K	509K	896K	1857K	308K		3K	4494K
4. Number of trunks in service YE 82 (Class 4 or 4/5)	57K	204K		16K	53K	3K	297K	19K	2713		3362K
5. Total systems and lines on order or expected YE 83											
Systems	N/A	39	650	145		1175	550*	N/A	98	N/A	
Lines	N/A	N/A	3M	320K		1.5M	5M		NA	N/A	
Trunks	N/A	250K	NA	139K		NA	700K		N/A	N/A	

*+525 remotes
N/A - Not Available
NA - Not Applicable

North American time division digital switching (largest offices)

	Local		Toll		Local/Toll	
System	**Location**	**Line**	**Location**	**Trunks**	**Location**	**Terminations**
ITT/North 1210	Jeff. City, Mo.	20K	Jeff. City, Mo.	2.3K	Roseville, Calif.	4K
No. 3 EAX	NA	NA	Calgary, Alberta	5.8K	NA	NA
No. 5 EAX	First Colony, Texas	6K				
NEAX 61	Victorville, Calif.	13.7K	Winter Park, Fla.	5.8K	Thomaston, Ga.	10.4K
DCO	Ville Platte, La.	7.5K	Boscobel, Wis.	1K	Middleton, Wis.	10.8K
DMS 10	Harrison, Ark.	6K	Pearce, Ariz.	250	Pinetop, Ore.	2.1K
DMS 100/200/300	Toronto	43.5K	Toronto	23K	Kitchner, Ontario	40K
ITS 4/5*	St. Mary's, Ga.	7K	Gander, Newfoundland	1.2K	Mauston, Wis.	6.5K
No. 4 ESS	NA	NA	Los Angeles, Calif.	70.4K	NA	NA
No. 5 ESS	Cedarville, Ohio	2K				

NA—Not Applicable
*—1981 data

The future of mobile communications and the ISDN

JAN E. ENGEBRETSON and JAN AUDESTAD

THE INTEGRATION of data and telecommunication technologies leads to rapid growth in the possibilities of handling all kinds of information. Land-based wired networks are being enhanced and developed for this purpose.

Mobile communication systems represent an important addition to these networks. Mobile communication devices carried by the individual can be used both at work and at leisure.

During the '80s, several land mobile networks will be put into operation in Europe. Some of them are based on the Nordic Mobile Telephone (NMT) system. Others are based on the NET-C system developed in the Federal Republic of Germany and one is based on the Advanced Mobile Phone Service of American Telephone & Telegraph Co. These networks incorporate such functions as:

- **Location registration.** The network automatically keeps track of where the mobile stations are located. Based on this information, it routes the calls to the proper location of the mobile station.
- **Call transfers.** When a mobile station moves from the area of one base station into the area of another during a conversation, the call is automatically transferred to the new base station without interrupting the call.
- **Call diversion.** The mobile subscriber may indicate that he wants all calls diverted to a given number in the fixed telephone network or to a specific recorded announcement.

The introduction of such facilities is a major step toward the modernization of land mobile communications. However, the networks that will be put into operation during the next 5 or 6 years are optimized for telephony. They are not appropriately designed for carrying such new services as teletex, digital facsimile or other digital services transported in the wired public networks.

Land mobile networks which are put into operation during the '80s will have a life span of at least 15 years. They will still be in operation toward the year 2000, long after the integrated services digital network (ISDN) has been introduced. It is important that the land mobile networks match the wired networks so the whole spectrum of new services can be offered through them. This implies that planning of the land mobile ISDN has to start now in order for it to be put into operation during the '90s. Before discussing the land mobile ISDN, an examination of the present situation is in order.

The importance of land mobile communications for modern society is well illustrated by the situation in Norway.

The first land mobile system in Norway, which offered nationwide manual service, was put into operation in 1967. In November 1981, the automatic NMT system was introduced in the eastern part of Norway. By 1985, the system will cover the entire country.

The NMT system is also used in Denmark, Finland and Sweden. The NMT networks of the four Nordic countries are interconnected by location registers. Subscribers in one

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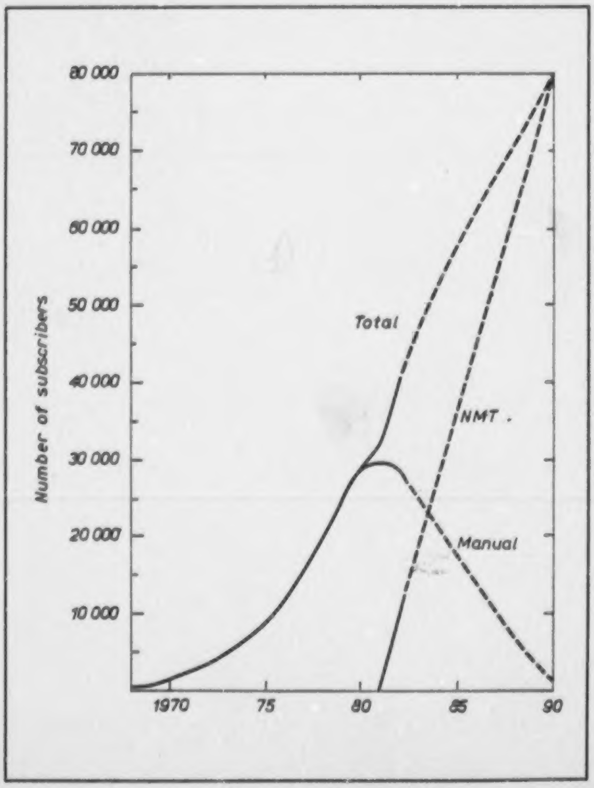
FIG. 1 *Number of land mobile subscribers in Norway.*



Jan E. Engebretson and *Jan Audestad* are both Engineers with the Norwegian Telecommunications Research Establishment in Oslo. This article was adapted from a paper presented at NORCOM '83, held May 3-7 in Oslo.

country may use their equipment in the other countries.

Since 1967, the number of land mobile subscribers in Norway has increased steadily (Figure 1). By the end of February 1981, Norway had about 30,000 subscribers of the manual service and about 13,000 subscribers of the automatic service. During the '70s, the manual service showed an annual growth of 300 to 400 subscribers. In contrast, the NMT system had 10,000 subscribers during the first year of operation. Figure 1 also shows the projected number of subscribers in 1990 when there will be approximately 80,000 land mobile subscribers. Around 1987, the NMT system in the 460 MHz (megahertz) band will become too congested. Therefore, planning has started on a supplementary system in the 900 MHz band based on NMT specifications.

Table 1 shows the current and expected number of cars equipped with mobile telephones: 3% of all cars are so equipped today; by the year 2000 this number will increase to 10%. By then 5% of all telephones in Norway would be mobile telephones.

The traffic in terms of the number of successful calls per year made by land mobile subscribers is shown in Figure 2. In 1982 the subscribers of the automatic service made 4 million calls, which is about the same number of calls made by the much larger number of manual subscribers. One reason for this is that the first users of the NMT system were people who needed a fast, reliable land mobile service. This assumption also is confirmed by Table 2, which compares average and busy hour traffic per subscriber for manual and automatic service. In the automatic service, the busy hour traffic per subscriber is four times the level of the manual service.

A recent market survery made among NMT subscribers shows a number of interesting points. The main users of the service work in five fields: sales (24%), construction (21%), transportation (18%), industry (14%) and services (13%). On average, each company had three NMT mobile stations. Most of them claimed that the main reason for using NMT equipment was to improve their efficiency; in other words, to avoid unnecessary driving and to increase their mobility.

Regional characteristics

The NMT system incorporates the location registration facility with the location registers of the four Nordic countries interconnected. The importance of this facility is illustrated by the fact that 13% of Norwegian subscribers have a requirement for also using their stations in other Nordic countries.

The NMT system also offers other benefits. The most important of these, as far as usage is concerned, is the diversion of calls to a number in the telephone network selected by the mobile subscriber. More than 50% of the subscribers have used this facility and 10% use it daily. Diversion of calls to a standard announcement and the prohibition of outgoing calls are capabilities which are used less frequently.

There is also increasing interest in non-voice services. Right now, telex represents 6% of usage; data transmission, 6%; facsimile, 5%; and video, 1%.

Except for telex, these services are now offered by using the same interfaces used for telephone circuits. However, the interest in these services seems to be large enough to justify direct interconnection with public data networks or the ISDN in the future.

The price of mobile stations and of charges per minute are shown in Figure 3. The real value price of manual stations has decreased to about 50% of the 1967 price. Even at the outset the real value price of NMT stations was less than the real value price of manual stations in 1967. During the last year, the price of NMT stations

Continued on page 110

Table 1

Year	Number of cars in millions	Number of mobile telephones	Relative number of cars equipped
1982	1.3	40,000 *	3%
1990	1.5	80,000 †	6%
2000	1.6	160,000 †	10%

*Manual and automatic system

† NMT forecast

Table 2

	Manual service	Automatic service
Average	0.0015	0.003
Busy hour	0.0033	0.013

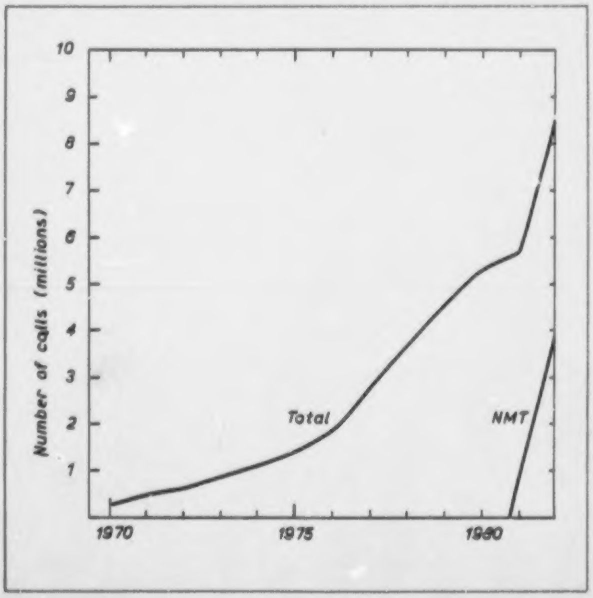
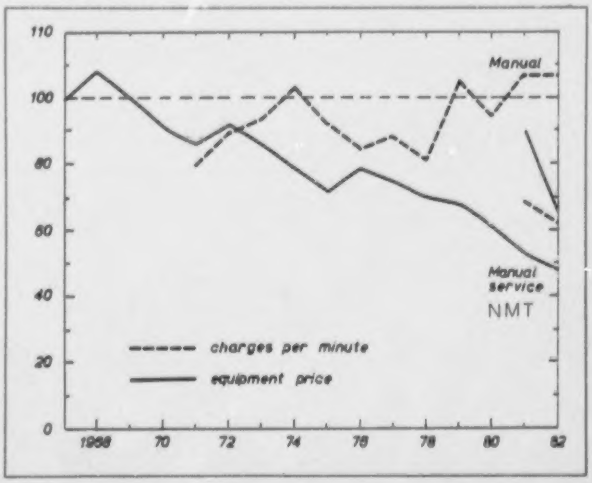


FIG. 2 *Number of successful calls per year.*

FIG. 3 *Development of cost of mobile telephone equipment and charges relative to the consumer price index since 1967.*



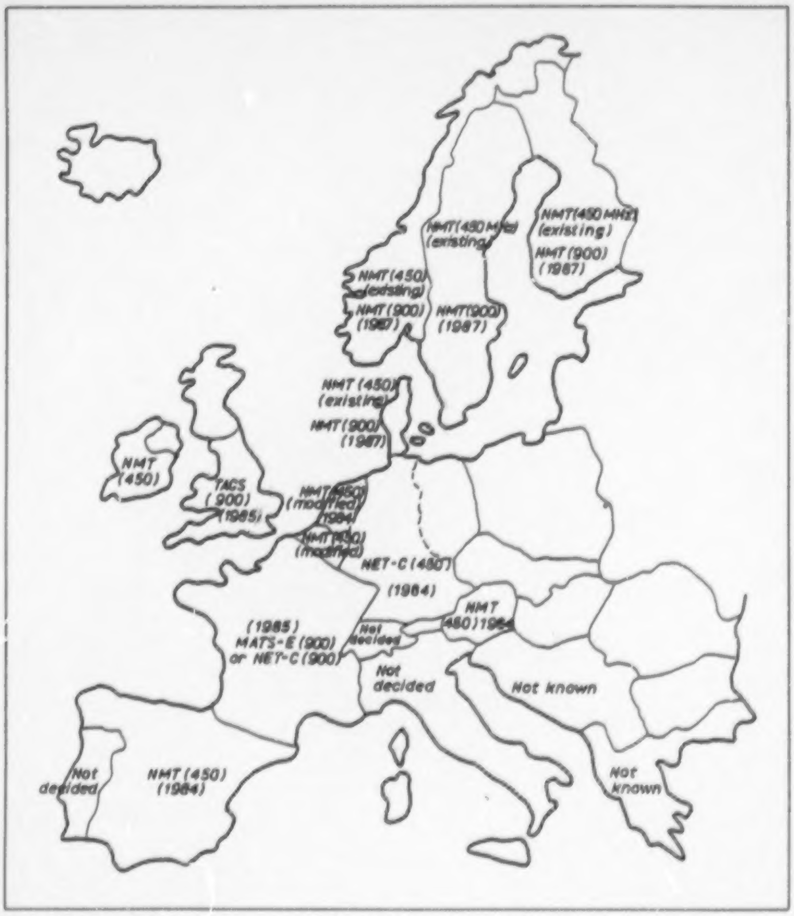
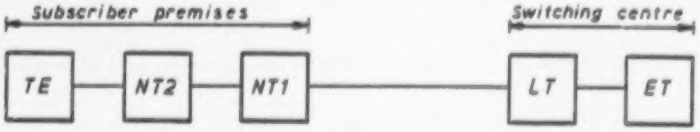
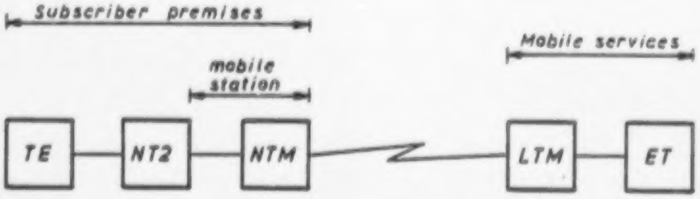

NMT(450 MHz) (existing)
NMT(450 MHz) (existing) NMT(900) (1987)
NMT(450) (existing) NMT(900) (1987)
NMT(900) (1987)
NMT (450) (existing) NMT(900) (1987)
NMT (450)
TACS (900) (1985)
NMT(450) (modified) 1984
NMT(450) (modified)
NET-C (450) (1984)
NMT 450) 1984
Not decided
(1985) MATS-E (900) or NET-C (900)
Not decided
Not known
Not decided
NMT (450) (1984)
Not known

FIG. 4 *Plans for and status of land mobile systems in Europe.*


Subscriber premises
Switching centre
TE
NT2
NT1
LT
ET

a) General composition of the subscriber interface to the ISDN


Subscriber premises
mobile station
Mobile services
TE
NT2
NTM
LTM
ET

b) Composition of the mobile ISDN interface

TE = terminal equipment
NT2 = network termination
NT1 = network termination (transmission)
NTM = network termination for mobile services
LT = line termination
LTM = line termination for mobile services
ET = excharge termination.

FIG. 5 *The ISDN concept applied to mobile systems.*

has dropped considerably. It is now comparable to the price of manual stations.

Charges for the manual service have more or less followed the general price development. For the NMT system the charges per minute are only 50% compared to the manual service. The charges are in fact even more favorable for the NMT system. Charges are based on 20 second intervals while the manual service is based on 1 minute intervals.

Internationally, Study Group II of the International Telegraph and Telephone Consultative Committee (CCITT) recently made a survey among member administrations on land mobile networks. Altogether 53 national telecom administrations (PTTs) or private operating agencies answered the questionnaire. Of the organizations which answered, 25 were already operating an automatic network and 11 more were planning to have one before 1990.

Most existing automatic networks were small. Only six automatic networks had more than 5000 subscribers, and only two had more than 15,000. By 1990 the number of subscribers was expected to increase on average by a factor of five, which indicates a rapid growth in land mobile communications.

A majority of the 25 administrations which already had an automatic network indicated that they would need a new network before 1990. Several reasons were given:

- The existing network did not offer nationwide coverage.
- New functions, such as location registration and diversion of calls, were required.
- The existing network was congested and did not have enough frequencies to meet the increase in traffic.

None of the administrations, except for the Nordic administrations, had plans for harmonizing their networks with networks in adjacent countries. This illustrates one of the main problems in land mobile communications: incompatibility between networks. The situation is demonstrated in Figure 4, where the various systems to be put into operation in Europe during the '80s are indicated. Great efforts have been made to standardize subscriber interfaces and end-to-end protocols for other telecommunications services, for example in public data networks and the ISDN. This not only ensures proper interworking among sub-

Continued on page 114

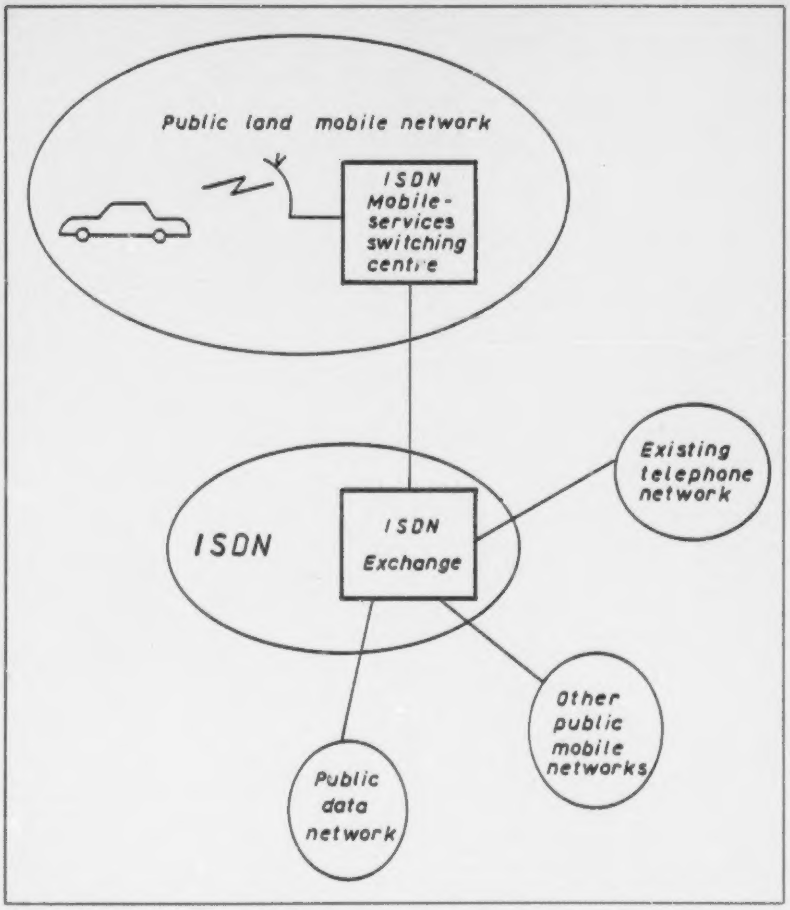

Public land mobile network
ISDN Mobile-services switching centre
Existing telephone network
ISDN
ISDN Exchange
Other public mobile networks
Public data network

FIG. 6 *Interconnection of a public land mobile network to other network.*

scriber terminals located in different countries or in different networks, but also results in cheaper equipment for a vast international market.

Bad situation

The current situation in the land mobile field is exactly the opposite. Important standardization work now is going on in the CCITT, but most European countries have shown little interest in this work. The CEPT (European conference of postal and telecommunications administrations) has also started working on a future land mobile system for Europe. But in this project, a lack of enthusiasm from many countries also is apparent. What is now required is a firm policy statement from national telecommunications authorities that such a system has to be introduced within a given time.

The market potential for land mobile equipment in Europe was assessed in a study made for the Eurodata Foundation in 1981. The study showed a need for between 5 million and 20 million land mobile stations, depending on price and, in particular, on their competitiveness against paging equipment. This clearly indicates that the market is big enough to encourage the development of a common European system which would provide services to all land mobile subscribers independent of their home country. If such a system is introduced in the early 1990s, it will supplement existing networks and replace them as these networks become obsolete.

Future land mobile networks may be divided into three groups:

- public land mobile networks;
- closed user group networks; and
- mobile local area networks (mobile LANs).

Each type of network would be required in order to meet specific customer needs.

The future public land mobile networks should be designed in accordance with the principles laid down for the ISDN. This implies that mobile stations should be capable of interfacing ISDN-compatible terminal equipment.

The principle is illustrated in Figure 5 where the standard ISDN interface is shown with the equivalent mobile interface.

The ISDN interface consists of the following elements on the subscriber side:

- the terminal equipment (TE), which corresponds to the actual subscriber terminal (in other words, the telephone hand-set); and
- the network terminations, NT 1 and NT 2, where NT 2 incorporates the necessary function for operating a multiterminal interface and NT 1 is the termination of the physical line.

On the exchange side two elements are required:

- the line termination, LT, which is complementary to NT 1; and
- the exchange termination, ET.

As shown in Figure 5, the land mobile system should be designed so that only the functions NT 1 and LT are different from those of the general ISDN interface. When this condition is satisfied, any type of terminal equipment used in fixed locations also may be connected to a mobile station.

The standardization of NT 1 and LT functions for land mobile applications would require considerable work in order to incorporate all procedures which are unique for mobile networks, such as location register updating and call transfer procedures. Due regard should be paid to the open system interconnection (OSI) architectural model being specified by the CCITT and the ISO (International Standards Organization).

Mobile services switching centers (MSCs) should also be designed in accordance with ISDN specifications. The MSC should interface the fixed network through an ISDN exchange. Since interworking must exist between the ISDN and other public networks, these functions will not be required at the MSC, thus simplifying the equipment. The overall configuration is shown in Figure 6.

Study Group XI (signaling and switching) of the CCITT recently decided to specify a mobile user part (MUP) of signaling system No. 7. The purpose of the MUP is to accommodate the variety of procedures which are required between public land mobile networks when subscribers are permitted to roam among them. Such procedures would include updating location register information, exchanging other information related to a given mobile station (activation or cancellation of supplementary services) and transfering charging information. Thus, MUP

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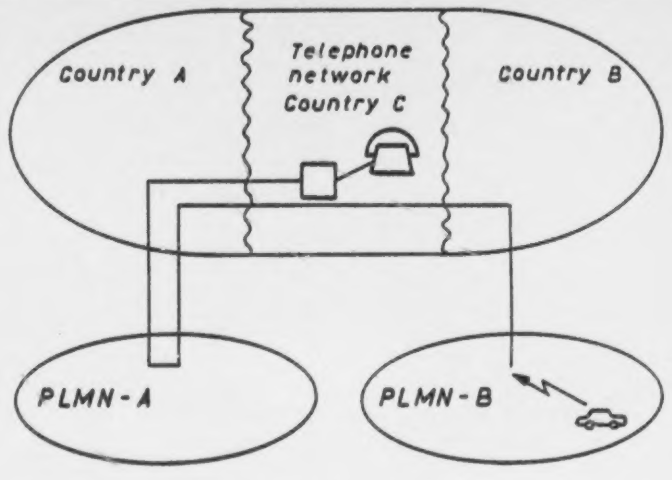
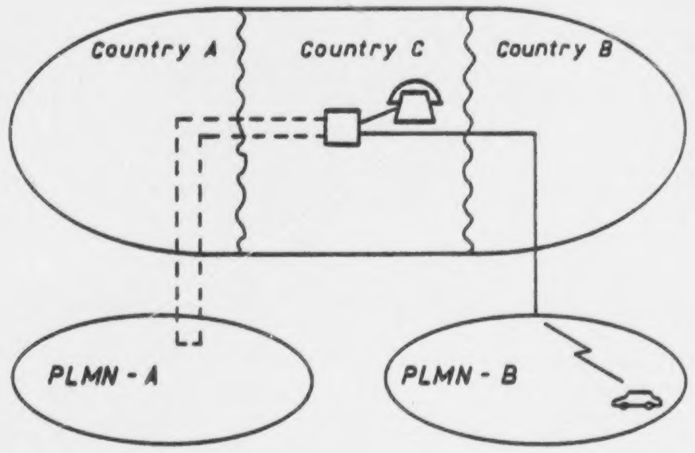


a) Example of excessive routing



b) Example of more efficient routing
---- signalling path
—— speech path

FIG. 7 *Routing of calls to a roaming land mobile subscriber.*

would represent a standard method of interworking among different land mobile networks, where the required information is passed via the signaling network of signaling system No. 7. Therefore, a separate signaling network among land mobile networks would not be required.

A major problem with mobile subscribers is that, if special precautions are not taken, the route from a calling subscriber of the fixed network to the mobile subscriber may become very long. This is illustrated in Figure 7a. In the example, a subscriber of country *C* is calling a mobile station registered in country *A* which has traveled to country *B*. With the existing telephone network, the speech path has to be routed to mobile network *A* first, be switched there and then be routed all the way back again to mobile network *B*.

However, Study Group XI is now considering possible extensions of the telephone user part (TUP) of signaling system No. 7 so that the loop through mobile network *A* on the speech path can be avoided. This can be done as shown in Figure 7b where the telephone network (or the ISDN) of country *C* has the capability of interrogating the location register of mobile network *A*. Based on routing information provided by mobile network *A*, the exchange of country *C* making the interrogation may route the call directly to mobile network *B*. In this case, only a signaling link has to be established between country *C* and mobile network *A*.

The same method would also be used if the called mobile subscriber has requested the activation of the

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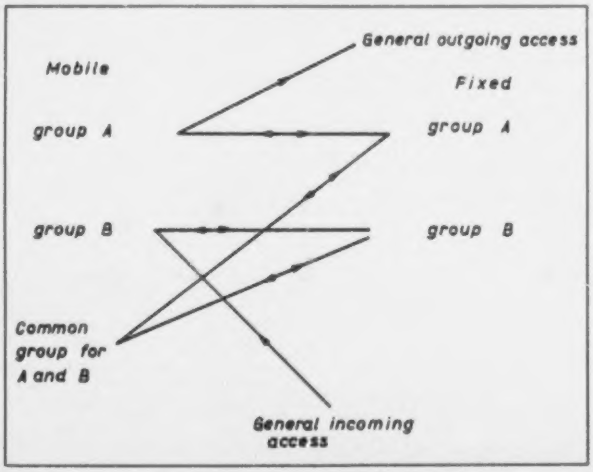
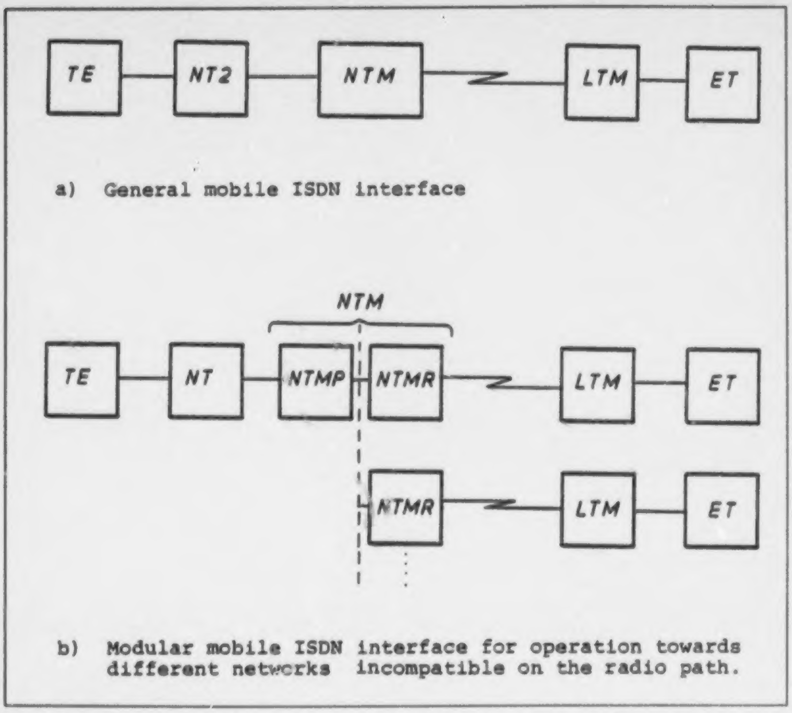


FIG. 8 *Example of two groups of users forming the following closed user groups: Group A has outgoing access from the mobile stations; Group B has incoming access to the mobile stations; there is also a common group for Group A and Group B which is closed from all access outside the group.*



a) General mobile ISDN interface

b) Modular mobile ISDN interface for operation towards different networks incompatible on the radio path.

FIG. 9 *Modular network termination for interconnecting mobile stations to a variety of mobile networks.*

call diversion procedure.

Therefore, the studies now being undertaken by Study Group XI on land mobile systems are very important for the future development of compatible interconnected land mobile networks.

The field of applications of land mobile communications is expected to expand in the future. A growing demand for non-voice services has already been detected in Norway. Mobile stations are not only used in cars but also on commercial ships, on pleasure boats, in trains and at fixed locations where connection to the telephone network otherwise would be too expensive. In order to meet specific communications requirements for supply ships in the North Sea, the heaviest traffic areas now are covered with NMT antennas directed toward the sea. Applied in a similar way, a future common European land mobile system would meet the communications requirements of the commercial fleet operating along the coast of Europe. This recently has become important because an international short range maritime system will not be developed until a common international frequency band exists for such a service.

More, more

There is also a growing demand for hand portable stations, mobile payphones and even mobile PABXs (private automatic branch exchanges). The latter would solve some of the communications problems at construction sites.

The concept of closed user groups was introduced for public data networks. The closer user group facility permits users to operate their own closed network within a public network; in other words, they neither are accessible by subscribers not belonging to the group nor can they access subscribers outside the group. In many cases, this is a severe restriction. Therefore, it is also possible to form groups with incoming or outgoing access. The former permits subscribers not belonging to the group to access subscribers within the group. The latter permits the opposite.

Within a public land mobile network, the closed user group facility should be made available in order to attract some subscribers who would otherwise prefer to have their own closed radio network. However, the implementation of closed user groups in land mobile networks may have implications for fixed networks. Land mobile subscribers normally would want to form closed user groups with fixed subscribers. Therefore, this facility should be incorporated in the ISDN and the control of closed user groups should be specified for signaling system No. 7.

Another way of implementing closed user groups is for the national telecom administration to establish a specific network for this purpose. The various groups would thus be using a common radio frequency spectrum. This would result in better frequency utilization and a cheaper network for each user group compared to the case when each group was operating a separate radio network.

Furthermore, users with a common interest (for instance, police and ambulance services) may decide to

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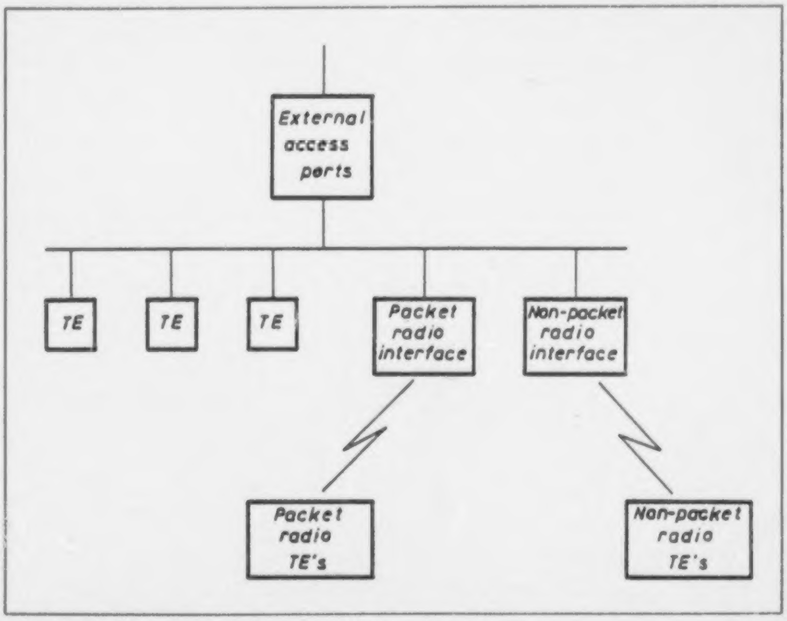

FIG. 10 *Local area network with radio interfaces.*

form a common group.

A user group may be either national or local. An example of some of the combinations that may exist for two groups is shown in Figure 8. Groups may have different closure conditions depending on the service; for instance, a group may be open for telephony but closed for data transmission.

Closed user group networks thus may become a competitive alternative to private networks. To make it even more competitive, mobile subscriber interfaces and protocols used on the radio path should be designed in accordance with those of the public land mobile network.

By subdividing the NMT function into a procedure part, NTMP, and a radio part, NTMR, as shown in Figure 9, the basic NTMP function may be used on a variety of networks operating in different frequency bands and with different modulation techniques on the radio path. Such a development should be taken into account when designing both public land mobile networks and closed user group networks.

'It is important that land mobile networks match the wired networks so the whole spectrum of new services can be offered through them. This implies that planning of the land mobile ISDN has to start now. . .'

During the last few years, great efforts have been made to improve local area communications. Possible solutions include sophisticated digital PABXs and high speed transmission systems, such as Ethernet.

In order to provide for the mobility of persons within the premises, PABXs incorporate functions like call diversion, hunting and automatic recall. Local radio paging has also been used to contact mobile users. All of these facilities have disadvantages. They are not always what the user wants.

User requirements can often be better met by mobile LANs. Mobile LANs would have to provide full duplex telephone service in some cases and full duplex data transmission service in other cases.

These diverse user requirements may be met with an LAN configuration as shown in Figure 10.

In the future, the LAN may consist of a variety of fixed interfaces and a number of different radio interfaces. For example:

- a packet radio interface for high speed data interconnections; and
- a non-packet interface for telephone and various forms for data transmission.

For telephony, the mobile equipment should be hand or pocket portable and about the same size as radio paging receivers. It should be possible both to receive and originate calls from mobile equipment.

With regard to communication protocols, mobile equipment should be fully compatible with fixed installations. This requirement is necessary to avoid expensive additional interfaces in PABXs or at other access points to which the equipment is interconnected.

The radio cells associated with mobile LANs should be small in order to facilitate efficient re-use of frequencies. The cell radius should be of the order of 100 meters or less.

The concept of mobile LANs may be extended to incorporate a more general public micro-cell telephone service for the home and the cordless telephone. A public micro-cell may be used for covering an airport, a shopping area or a public park. It may be possible to access these networks by a cordless telephone or a portable phone used in an LAN. However, there are a number of technical and operational problems that must be resolved before a general mico-cell system can be realized.

These problems include:

- numbering and identification plans;
- charging; and
- location registration and location register updating.

If a common solution can be found for the cordless telephone, mobile telephones used in LANs and the public micro-cell systems, there will be an enormous market for such equipment, according to the study done for the Eurodata Foundation in 1981. If an inexpensive terminal which cost about $100 were designed, the European market alone is capable of consuming 165 million terminals.

In the past there has been virtually no cooperation among countries regarding land mobile networks. The Nordic countries are the exception. There a common effort has resulted in a technically advanced mobile system. Internationally, standardization of land mobile services is under the province of Study Group VIII of the CCIR (International Radio Consultative Committee). Despite several years of effort in this field, little has been accomplished. The first real initiative came from the CCITT, where the need for international standardization of services is better appreciated. However, standardization of mobile services includes aspects which are unknown in other fields, such as:

- allocation of a common frequency band with sufficient capacity to accommodate the required number of subscribers;
- agreement between countries on the use of land mobile equipment in countries other than the user's home country; and
- harmonized procedures for type approval.

For a common public land mobile system for Europe, the first point is resolved by using the land mobile band in the 900 MHz range. However, this band may not have sufficient capacity for the future. With regard to the other networks, the frequency situation is by no means clear.

The second point is far more complicated since it involves political factors beyond the scope of telecommunications authorities.

International harmonization of type approval procedures has been unsuccessful. Since this is within the responsibility of the national telecommunications administrations, it is likely that a solution will be found only after the decision for introducing the service has been made.

In spite of all the difficulties which must be resolved, truly individual communication will develop out of it. Transceivers will be considered simple extensions of paging devices, like the portable entertainment radio receivers commonly used today. Together with mobile cellular systems, these devices will represent exciting new possibilities for individual two-way information systems. ☐

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Maritime communications sail into bright international seas

OLOF LUNDBERG

THE MARITIME community has long recognized the need for improved, reliable, high quality telecommunications offering the same level of service that a land-based subscriber has come to take for granted. Although much improved in recent years, conventional maritime communications still suffer from ionospheric disturbances, crowded air waves and other problems which have led to delays of hours, if not days, before a call can be completed. Not only have these delays been a handicap to improving the efficiency of shipping generally, they have sometimes been disastrous in emergencies.

To overcome this situation, the International Maritime Satellite Organization (INMARSAT) was established as a result of an international conference convened by the International Maritime Organization, an agency of the United Nations. Twenty-eight countries signed the convention; there are now 39 member countries (Figure 1). Tunisia was the latest country to join.

INMARSAT has a three-tier organizational structure: an assembly of parties (or states); a council of signatories who have invested in the organization; and a directorate based in London. Where we differ from our sister organization, INTELSAT (International Telecommunications Satellite Organization), is that we have several East European member countries, notably the Soviet Union, Poland and Bulgaria.

Components

The INMARSAT system has three major components, none of which is meaningful without the others. These are the satellites, which we now lease from the MARISAT joint venture, the European Space Agency and INTELSAT; the coast earth stations, which are operated by signatories and which give access to national and international telecommunications networks; and the ship earth stations.

INMARSAT was formed in July 1979 and has been operational since February 1982. In the first year of operation, the number of users of the system increased by about 60%—at a time when international shipping was suffering its worst economic crisis since the 1930s. We now have slightly fewer than 1800 users, including oil tankers, offshore drilling rigs, cargo and container vessels, passenger liners, cable laying ships, seismic survey vessels, yachts, tugs and ice breakers.

Although our first year's growth rate was impressive (it was actually better than we had expected), the economics of providing satellite communications for mobile users is marginal, demanding a cooperative effort on the part of the international community. Just as the shipping industry has become an international business, the mobile user requires an international system. National or regional satellite systems for such a small dispersed market do not make sense, either in terms of logistics or finance.

However, INMARSAT does not intend to be perceived as having a monopoly nor shall we act as if we do. We recognize that we can only justify our existence on the excellence of the services we provide and on our ability to meet users' requirements. We must be guided by those requirements, or rather by an enlightened and imaginative matching of technology with users' needs. To that end, it is essential that users make their requirements known.

The INMARSAT satellite system is somewhat different from most other satellite organizations which provide a fixed or DBS (direct broadcast satellite) service. We interface directly to the end user's telephone set on the mobile side of the satellite. We and our signatories extend terrestrial telecommunications networks to the oceans of the world. When someone on board a ship picks up the telephone, he is using the ultimate in cordless telephones.

The INMARSAT system is also characterized by a very large number of earth stations. Because ours are highly volatile mobile end users, we are faced with a major technical and administrative challenge. The traffic volume per terminal is generally small, often only a few minutes per day. The small mobile antenna necessitates high satellite power and thus creates a high production cost per circuit.

To place or receive a call, the user has a ship earth station. The only ship earth station type-approved so far by INMARSAT is known as the Standard A. The ship earth station can be purchased from and installed by more than a dozen suppliers around the world. It consists of above and below deck equipment. Below deck are the telephone, telex, data and facsimile machines connected to the above deck unit, which consists of a parabolic antenna ranging from 0.8 to 1.2 m (meter) in diameter. A sophisticated stabilization system, which accounts for its price being higher than its terrestrial counterparts, keeps the dish constantly tracking the satellite despite the ship's course and movement. Once the call is dialed, the signal is transmitted from the satellite to the coast earth station, where it is switched to national and international networks.

Technical developments

For now and probably until the early 1990s, the Standard A, which is an analog terminal, is likely to remain the all-purpose workhorse of the INMARSAT system.

Development work is proceeding, however, on other possible standards to meet the needs of high and low volume users. These new standards could reach the market at approximately the same time as INMARSAT's second generation satellite system does in 1988.

Our next generation satellites will

Olof Lundberg is Director General of the International Maritime Satellite Organization (INMARSAT). This article was adapted from a speech he delivered at the Satellite Summit Conference, held May 17-19 in London.

be required after 1988. The request for proposals (RFPs) were recently issued. They call for satellites with three to four times the present capacity. The planning and procurement of our second generation satellite system is the organization's major priority.

The development and use of satellites have truly brought about a revolution in maritime communications, so much so that the present Morse and complex manual systems will be phased out over the next decade. They aleady are being replaced by a simple, automatic communications system, which anyone can easily use. Such systems can also make a significant contribution to the safety of life and property at sea, giving new facilities to shore-based rescue authorities which will, for example, be able to make group calls to ships in the vicinity of an emergency.

In the longer term, a driving force in the development of new terminals will be the requirements of the future global maritime distress and safety system (FGMDSS) which is being specified by INMARSAT to help protect life and property at sea. As a result of the FGMDSS, we expect that most vessels on the high seas will use INMARSAT services in the 1990s.

USA	Communications Satellite Corporation (COMSAT)	23.36370
USSR*	Morsviazsputnik	14.09217
UNITED KINGDOM	British Telecom	9.89134
NORWAY	Norwegian Telecommunications Administration	7.87821
JAPAN	Kokusai Denshin Denwa Co., Ltd.	6.99915
ITALY	Ministero delle Poste e Telecomunicazioni	3.35524
FRANCE	Direction Generale des Telecommunications	2.88553
GERMANY, FEDERAL REPUBLIC OF	Bundesministerium fur das Post und Fernmeldewesen	2.88553
GREECE	Hellenic Telecommunications Organization (OTE)	2.88553
NETHERLANDS	Netherlands PTT Administration	2.88553
CANADA	Teleglobe Canada	2.61717
KUWAIT	Ministry of Communications	2.01315
SPAIN	Compania Telefonica Nacional de Espana	2.01315
SWEDEN	Swedish Telecommunications Administration	1.87898
AUSTRALIA	Overseas Telecommunications Commission (OTC)	1.67770
BRAZIL	Empresa Brasileira de Telecomunicacoes S.A. (EMBRATEL)	1.67770
DENMARK	Post and Telegraph Administration	1.67770
INDIA	Overseas Communications Service	1.67770
POLAND	Office of Maritime Economy	1.67770
SINGAPORE	Telecommunication Authority of Singapore	1.67770
CHINA, PEOPLE's REPUBLIC OF	Beijing Marine Communications and Navigation Company	1.23666
ARGENTINA	Empresa Nacional de Telecomunicaciones (ENTEL)	0.60395
BELGIUM	Regie des Telegraphes et des Telephones	0.60395
FINLAND	General Directorate of Posts and Telecommunications of Finland	0.60395
NEW ZEALAND	Post Office Headquarters	0.36277
BULGARIA	Shipping Corporation	0.27204
PORTUGAL	Companhia Portuguesa Radio Marconi	0.20610
ALGERIA	Ministere des Postes et Telecommunications	0.05000
CHILE	Empresa Nacional de Telecomunicaciones S.A. (ENTEL-CHILE)	0.05000
EGYPT	Telecommunications Organization	0.05000
IRAQ	Republic of Iraq	0.05000
LIBERIA	Republic of Liberia	0.05000
OMAN	Sultanate of Oman	0.05000
PHILIPPINES	Philippine Communications Satellite Corporation (PHILCOMSAT)	0.05000
SRI LANKA	Overseas Telecommunication Service	0.05000

---

* includes the initial investment share of Byelorussian and Ukrainian SSRs

FIG. 1 *Signatories of INMARSAT and their percentage of investment shares.*

Help in bad times

The INMARSAT system may also be used to bring relief in national disasters on land. Disaster relief agencies are able to use satellite terminals to restore communications in areas stricken by flood, fire or earthquake. Such use of INMARSAT terminals has been authorized.

In some areas where there are either no communications or only inadequate communications, some users or potential users may be tempted to use INMARSAT terminals. Where there is no economic alternative, this may seem to make sense, but it poses institutional difficulties for us. For one thing, it is outside the scope of INMARSAT's mandate to provide communications for fixed services. At an international level, this is within INTELSAT's purview, but INTELSAT does not have the facilities for such services at present and some of our members are anxious to be able to satisfy these requirements.

INMARSAT is required to operate on a commercial basis. Its signatories are increasingly responsive to user needs. Thus, if the institutional difficulties could be resolved satisfactorily, INMARSAT could, in the short term, support important international thin route traffic very quickly and at a relatively low cost to the user. However, this can only be a short term solution because our system is not designed to provide services of this nature on a permanent basis. Our prime duty is the provision of high quality services to the maritime mobile community. At best, we can handle thin route traffic on an *ad hoc* basis as a stop-gap measure.

Although INMARSAT was created to serve maritime requirements, other possible applications were foreseen at the international conference which conceived the organization. Some of the applications, the feasibility of which we are exploring, relate to navigation via satellite and aeronautical communications.

During the last 30 years, a large number of radio navigation systems have been developed. Decca, Loran-A, Loran-C, Omega and The Tsikada and Transit satellite systems have been used by various sectors of the marine industry for general navigation purposes. There is, however, no single system which satisfies the needs of all mariners for all purposes.

We continue to observe the growing interest in a navigational system under international control. Indeed, the point was raised at the United Nations conference on the peaceful uses of outer space, or Unispace 82, held in Vienna in August 1982.

Unispace 82 concluded that "a long term answer to the needs of the many actual and potential user countries needs to be devised." It further observed that "a single worldwide system seems very attractive since it would ensure compatibility and yet require a much lower investment from interested countries because space segment costs could be shared."

INMARSAT is examining such a scenario. To this end, the INMARSAT research and development program includes study of the possible use of non-geostationary satellites to augment coverage for INMARSAT services in polar regions not covered by INMARSAT's geostationary satellites.

Although INMARSAT is interested in providing a navigational capability, we have made no commitment to do so. Since money does not grow on trees, even if we could provide such a capability, who would pay for it? Or, equally important, how could such a

Continued on page 73

service be provided at low cost?

If a polar-orbiting satellite system were to complement the existing geostationary system, it might conceivably meet three requirements: a worldwide navigational capability, if a navigation satellite system under international control is deemed desirable and viable; a total global satellite visibility for a worldwide EPIRB (emergency position-indicating radio beacon) system also usable by aircraft ELTs (emergency locator transmitters); and low volume L-band communications for ships and aircraft in the polar regions. Above all, it must be cost effective.

The INMARSAT council recently approved an amendment to INMARSAT's draft request for proposals for its second generation satellite system which will provide an aeronautical capability. This would principally involve an extension of the upper end of the L-band bandwidth by about 1 MHz (megahertz), with a slight shift of C-band feeder link frequencies. The decision follwed a recent expression of interest in such a facility by the International Civil Aviation Organization. The fact that our second generation satellites will incorporate a small part of the aeronautical L-band does not mean we are committed to providing an aeronautical service, nor that the aeronautical community is committed to using it. At this stage, it merely means that we could provide it, subject to detailed consultations between INMARSAT and the aeronautical community.

Uses

Aircraft could use satellites for air-to-ground data links for air traffic control, for transmission of airline operational data and weather reports, and for passenger telex services. Among the factors which favor cooperation between the maritime and aeronautical communities are the adjacency of frequency bands which provides the opportunity to use common satellite facilities and similar terminals; the coverage of INMARSAT satellites of all major routes; and the prospect of mutually beneficial economies of operation.

Indeed, these points prompted the 1975-76 international conference to recommend "the study of the use by INMARSAT of multi-purpose satellites providing both a maritime mobile and an aeronautical mobile capability." What we are proposing, therefore, to the aeronautical community is a low cost, low risk, low commitment start-up system in which they would share space and possibly ground segment facilities with maritime users until dedicated aeronautical facilities could be justified.

Nevertheless, there does seem to be growing enthusiasm and interest in such a scheme. U.S. Federal Aviation Administrator Lynn Helms recently said that "time has come for the aviation community to make an objective, dispassionate and systematic assessment of the value of space technology applications to civil aviation." He noted that "the civil aviation community has failed to examine aviation's problems, needs and technical solutions involving space technology in a well considered, systematic manner."

While cooperation between the two user groups makes tremendously good sense, all solutions should be driven by user requirements. We continue to have discussions with aeronautical industry organizations and they are actively studying the use of satellites to solve some of aviation's communications problems.

Other possibilities

As for land mobile, INMARSAT continues to be asked whether we will eventually be able to provide such service. INMARSAT is a reasonable possibility if a thin-route international land mobile system is required. It is not a system which could be used for high density applications; terrestrial systems should be used in those, mostly urban areas.

An immediate challenge for INMARSAT is to reach that state of felicity where red ink is balanced by black ink. The formation of INMARSAT amounted to an act of faith by governments and by signatories. It is now fair to characterize INMARSAT as a going concern. It is doing better than initially expected and, as a consequence, that act of faith is being rewarded. Thus, we have moved forward the date when we expect to break even.

Although we have not yet reached that state of felicity, we are getting close—close enough that it would not be premature to view INMARSAT as a successful model of international cooperation established to meet a real need and doing exactly that. INMARSAT can also represent a challenge to governments, to other international organizations and to opinion leaders to think more in terms of what can be achieved through consensus and cooperation.

The challenge is to think international. ☐

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MCI Communications launches electronic mail service, p.22

Cover: Which side are you on in the access charge debate? Champions of each side argue their points and let the chips fall where they may, beginning on p.28

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Access charges:

Some see conflict with universal service

The debate over the effects of the FCC's recent access charge order and its threat to universal telephone service continues. Several bills pending in Congress would curb or modify the FCC's decision, before the Jan. 1, 1984, divestiture of the Bell System. The National Governors' Assn. has established a task force on Universal Telephone Service to review this sensitive issue. On Sept. 7, the task force met in Chicago for a fact gathering hearing, which included testimony from members of the telecom industry. The task force's recommendations are expected later this month. These articles, which present opposing viewpoints, are adapted from presentations made before the task force.

BENNET R. MILLER

MY OPINIONS concerning the preservation of universal telephone service represent the position of Tri-County Telephone Co., New Richmond, Ind., which serves 2500 customer access lines in four exchanges, as well as the views of the Organization for the Protection and Advancement of Small Telephone Companies (OPASTCO).

For many years, as the industry moved inexorably toward a full competitive environment, representatives of small telephone companies have expressed concern about the impact of the changes in the telephone industry on subscribers in rural America. The goals of preserving universal telephone service and moving toward a competitive telecommunications industry often are in conflict. Only Congress can resolve these issues and enact sufficient protections to assure continued availability of telephone service.

I do not ask that the clock be turned back. Technological advances, the divestiture of American Telephone & Telegraph Co. (AT&T), and Federal Communications Commission (FCC) and court decisions have made it clear that the telecommunications industry of tomorrow will develop in a competitive marketplace and will not be characterized by monopoly provision of any services.

People in rural America also want to be part of this technological revolution. Small Independent telcos also want to participate in the Information Age, but are concerned that telephone service may be priced beyond the reach of many subscribers if modifications are not made to recent FCC decisions. Subscribers in rural America, indeed all Americans, should continue to have high quality telephone service at rates which are affordable.

Maintaining universal service at reasonable rates as the industry becomes fully competitive is no easy task. Congress has been struggling with these competing goals for more than 7 years. The issues are now

Continued on page 32

Bennet R. Miller is President of Tri-County Telephone Co., New Richmond, Ind. He also is President of the Independent Telephone Pioneer Assn. (ITPA). This article has been adapted from a speech Miller presented to the National Governors' Assn. Task Force on Universal Service, Sept. 7 in Chicago.

Access charge conundrum

THE VEXATIOUS issue of access charges is currently preoccupying the telecommunications industry and many Congressmen. This article presents views from both sides.

The first part of the article, which begins on this page, is by President Bennet R. Miller of Tri-County Telephone Co., New Richmond, Ind., and an active member of both the Organization for the Protection and Advancement of Small Telephone Companies (OPASTCO) and the U.S. Independent Telephone Assn. (USITA). Miller proposes to use funds contributed equitably by all telecommunications carriers to cushion the effects of competition on rural telephone subscribers and, thus, to preserve universal service. Miller suggests that Congress should pass legislation to effect this goal and defines five points which such legislation should include.

The second part of the article, which begins on the following page, is by Executive Vice President Carl E. Horn of Illinois Bell Telephone Co. Horn argues that competition will reduce some costs, that phone service will still be relatively inexpensive, that the separations procedure used to cushion high cost customers has had disadvantages of its own and, finally, that the solution to the problems involved in the transition to a competitive market will not necessarily be resolved by renewed government intervention in the market.

Both cases are closely argued and helpful to readers who want to review the issue in detail.

Who is the distinguished gentleman gracing this week's cover?

The cover art for this issue comes from a slide show put together by the Public Relations Committee of USITA to help telcos explain the USITA position on access charges to the public. The slide show centers around an analogy. There is an imaginary island which lacks telephone service. After smoke signals and drums fail to provide the desired quality of communication with another imaginary island, residents of

pros and cons

Others see little threat to service

CARL E. HORN

THERE are two principal reasons why local telephone service will cost customers more next year than it has this year:

- Costs for providing local service will continue to increase, including expenses for labor, depreciation, taxes and postage; and
- The Federal Communications Commission (FCC) will require all customers to pay at least a $2 per month fee for access to the interstate telephone network.

Technically, only the first reason necessitates higher customer costs. The second reason reflects the FCC's decision to have telephone companies collect some of the subsidy that flows from long distance calls to local service on a flat fee basis—and less in the cost of the call. But many customers will think of this change as a rate increase for local service, even though long distance rates are expected to go down. This raises a key question.

Will these rate increases cause subscribers to drop off the telephone network? Or, to restate the question in other words, do these changes pose a threat to universal telephone service?

In general, the answer to this key question is: "No."

There are a number of reasons for this answer. Among the more important reasons are that:

- There are many service options from which customers can choose, in order to reduce their total spending for telephone service, without dropping off the network.
- Telephone rates have increased in the past 10 years by about 60%, but the number of people with telephone service has never been greater. The 60% national average increase compares with more than 100% increase in the consumer price index (CPI) and only a 40% increase in telephone rates in Illinois.
- Telephone service is, and will remain, relatively inexpensive compared to many other goods and services, such as electricity, food and clothing.

Of course, the impact of telephone rate increases will vary in the future as it has in the past. Some states will experience increases faster than others. But that is true of many other things, too; the rate increase impact in any particular area is a consequence of the economic characteristics of the area. Is it costly to do business there? Is the economy growing rapidly? Have costs been held down artificially in the past?

Clearly, there are many changes occurring in telecommunications.

Technology. Technological capabilities are changing rapidly. New telephone equipment, such as switchboards and telephones, is almost all solid-state electronic gear with extensive capability for software programing. Telephone companies no longer have a monopoly to provide that equipment.

Technological changes are also remaking long distance telecommunications. Satellites, fiber optics and electronic switching, including distributed processors, have persuaded regulatory agencies and federal courts that competition is better than monopoly for long distance communications. Technological change is certain to continue apace.

Competition. Once the natural monopoly barriers were set aside—ultimately by the courts in all cases—rapid changes swept through the telecommunications industry. In general, the judgment of Americans is that competition among suppliers is better than regulated monopoly for meeting

Continued on page 32

Carl E. Horn is Executive Vice President of Illinois Bell Telephone Co., Chicago. This article is adapted from a presentation Horn made to the National Governors' Assn. Task Force on Universal Service, Sept. 7 in Chicago.

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the first island create long distance telephone service, which leads to a demand for local telephone service. Eventually, both types of service are provided, but local service is more expensive to provide.

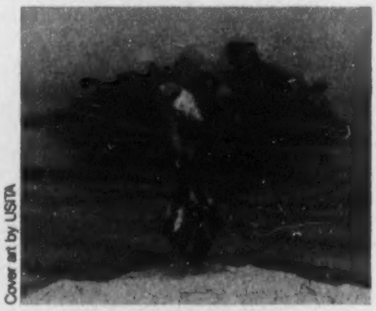
In order to keep the price of local service low enough for users to afford, revenues from overpriced long distance service are diverted to underpriced local service. A competitor emerges who offers long distance service at a lower price because he is not contributing to the pool of funds used to help keep local service on the island underpriced.

This causes a familiar problem. Finally, the island's leader decides upon a solution: the island society needs an access charge to make up for lost long distance revenues.

Then the show shifts to a discussion of the Federal Communications Commission's access charge plan and other related issues currently troubling the industry.

The 14-minute show includes more than 80 35-millimeter slides packaged in a carousel and an audio tape in standard cassette form. USITA also provides a support kit. The kit includes a speech, a comprehensive bill insert on access charges, a sample question and answer booklet for distribution to audiences, a sample edition of PhoneFacts '83, a news release on the user's first public presentation, a typed script for the complete slide show and guidelines on how to use the slide show, the kit and the equipment.

For additional information about the slide show, contact Becky SuPrise at USITA, 1801 K St., N.W., Suite 1201, Washington, D.C. 20006. ☐



Cover art by USITA

An informed resident of an imaginary island grappling with the access charge issue pauses to reflect on economic realities in the USITA film. The transition to competition clearly is no easier for him than it is for people in the real telephone industry.

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clearly focused; the solutions are at hand. We cannot afford to wait and see how many subscribers are left without telephone service when we have the ability to prevent such a consequence now.

Legislation to preserve universal telephone service should address several crucial principles:

- All providers of telecommunications services, including bypassers of local facilities, should contribute equitably to the costs of providing local telephone service.
- A Universal Service Fund (USF) to deal adequately with telephone service in high cost areas must be developed.
- Consistent and uniform regulatory policies between federal and state jurisdictions should be implemented.
- End users should not pay directly for the costs of the local telephone lines.
- Toll connecting links for which costs are significantly higher than the national average should be compensated for with funds from the USF.

Each of these principles will be addressed here.

All providers of telecommunications services should contribute fairly to the costs of providing universal service. Providers of telecom services which bypass the local distribution facilities of exchange carriers also should share the cost of these local facilities. Although competition has increased and alternative technologies have been developed, there has not been a stampede of carriers serving high cost rural areas or residential subscribers. Competitors have entered markets which are profitable and have not chosen to serve the high cost and lower density markets. Yet all telecom service providers benefit from the universality of telephone service; all providers benefit from using existing facilities as a back-up or to expand their own networks. Their profitability is increased by universally available phone service. Therefore, they should all contribute to the cost of preserving these universal local facilities.

Legislation should ensure that USF is created which will adequately protect exchange carriers that serve high cost areas. Exchange carriers for which costs exceed the national average by more than 110% should be eligible to receive funds from the USF. These eligible carriers also should recover all of their costs from the USF which exceed the national average in order to ensure that they are able to continue providing service in high cost areas and that their customers are able to afford telephone service.

As competition in telecommunications has been sanctioned by the federal courts and the FCC in recent years, there has been increasing conflict between the federal and state regulatory bodies. Consistent regulatory policy is essential to the continued financial viability of telephone companies. As Congress establishes clear goals for national telecommunications policy, it should act to ensure consistent regulatory policy at the federal and state levels. As telcos try to provide high quality service to customers and take advantage of new technology to reduce costs, they suffer from constant confrontations between federal and state regulatory policies. Congress can eliminate these needless and costly regulatory battles by setting a clear national policy direction. The economic health of small Independent telcos, and thus their ability to serve customers, depends on it.

The FCC's decision in Docket 78-72 would transfer, over a transitional period, most costs of the customer's access line to the interstate telephone network directly to subscribers or end users at a flat rate. This would be true whether or not these customers ever make a long distance call. The essential rationale for the FCC's decision was to prevent the uneconomic bypass of local facilities by heavy users of telecommunications services who pay a disproportionate share of the fixed cost of local facilities through usage based rates. The FCC went too far; by attempting to cure one problem, it has created another.

The transfer of all fixed costs to end users places an excessive burden on residential customers, particularly in high cost rural areas. If these costs are charged directly to customers, many will not be able to continue their basic telephone service. Furthermore, if end users must pay all local loop costs on a flat rate basis, there is no incentive for exchange carriers to make investments in modern facilities. Interexchange carriers depend on these facilities and benefit from continued upgrading and introduction of new technology.

Congress should change this portion of the FCC decision and modify end user charges.

In low density rural areas, the costs of providing service between the local telco's central office and the toll network are exceedingly high. These toll connecting links—or Class 4 to Class 5 links—constitute the portion of the telephone network where there is the greatest cost variance. If exchange carriers are forced to charge interexchange carriers directly for the costs of these toll connecting links, the pressure to deaverage toll rates for calls into and out of rural areas will be severe. The USF should provide a contribution to the cost of these high cost toll connecting links in order to prevent excessively high toll rates for rural areas.

Congress must act now to preserve universal telephone service. ☐

Continued from page 29

their needs. The gains made by competitors in telephone equipment and long distance service bear out that judgment.

All the costs assigned to long distance service have been paid for with each call. But a large portion of the price of each call does not depend upon characteristics of the call itself, such as how many minutes the call lasts, how far it goes, or whether or not the call is completed. Those calls have a large margin of subsidy, due to uneconomic cost allocations, that are built into the rate structure. It is that large margin of uneconomic costs for regulated carriers which has brought competitors into the marketplace, facilitated by technology and judicial orders.

The way long distance calls are priced will have to change. The price will certainly be reduced when the FCC's access charges are implemented.

Telephone ratemaking. Telephone rates have been—and still are—set in regulatory proceedings. That process takes a great deal of time and depends on prior rate cases which brought rates, in both structure and level, to where they are today. Those proceedings also are subject to a great deal of public and political attention. Telephone ratemaking, which has been carried on in a monopoly setting for more than 50 years, has not changed nearly as quickly as technological and competitive circumstances have. This is one of the principal causes of the current debates between federal and state regulators, and among regulators and

Continued on page 34

Table 1
1982 interstate-intrastate separations
Selected states ($ million)

Net gainers		Net losers	
Arizona	$ 64	Illinois	$ 73
California	280	Massachusetts	78
Florida	263	New Jersey	197
Montana	26	Pennsylvania	153

legislators, over access charges, depreciation and federal pre-emption in these areas.

Telephone ratemaking will have to change more rapidly in order to reflect cost and economic performance criteria. The comfortable customs of implicit subsidies among services—from interstate to intrastate; from toll to local; and from business to residence—will have to change.

Ratemaking subsidies. In 1982, about $10 billion in revenue requirements (customer payments) were distributed by the separations process. That process was a hallmark of historical natural monopoly regulation, but cannot continue in the emerging competitive era.

It will be difficult to move away from the separations subsidy because that subsidy was built up very unevenly through the years. For instance, consider some of the dollar flows that result from the interstate-intrastate separations process in 1982, as shown in Table 1.

Table 2
1984 separations, with freeze
Selected states ($ million-estimated)

Net gainers		Net losers	
Arizona	$ 82	Illinois	$138
California	438	Massachusetts	102
Florida	320	New Jersey	262
Montana	27	Pennsylvania	194

Table 3
1984 separations, under access charge order
Selected states ($ million-estimated)

Net gainers		Net losers	
Arizona	$ 88	Illinois	$103
California	210	Massachusetts	71
Florida	288	New Jersey	167
Montana	24	Pennsylvania	190

Table 4
1984 separations, if USF is fully employed
Selected states ($ million-estimated)

Net gainers		Net losers	
Arizona	$ 1	Illinois	$42
California	-57	Massachusetts	26
Florida	182	New Jersey	50
Montana	9	Pennsylvania	38

In general, the net payers of the subsidies are industrial, heavily populated states in the Midwest and Northeast.

The separations system generally is regarded as having gone too far in the redistribution of revenues among the states. A joint board composed of state and FCC commissioners froze one element of the separations formula effective early in 1982. But, even with that freeze, the net flow of dollars from the old industrial states of the North would have continued in 1984 (Table 2).

However, under the FCC's access charge order, the situation in 1984 would be somewhat better for the Northern industrial states (Table 3).

The separations process is not well correlated with either economic cost causation or with emerging competitive realities. In addition, many states created subsidies through the years by raising state toll rates above economic cost and keeping local exchange rates well below economic cost. It is understandable that any explicit adjustment of such a well entrenched set of implicit subsidies will be difficult.

> **'. . . the impact of telephone rate increases will vary in the future . . . .'**

FCC access charges (Docket No. 78-72). The FCC has looked at the issue of subsidies in the context of developing long distance competition since early 1978, and as early as 1980 proposed one method of dealing with them. The most recent FCC order on this subject requires a flat $2 per month charge per residential customer to recoup some portion of the heavy subsidy now built into every long distance call. The balance of the access charges will be levied on the interexchange carriers and in 1984, with the end user charges, will match the amount of revenues that would have been generated by the separations process.

By 1986, however, the separations process itself will begin to change so that the subsidy flows are narrower in the future. The FCC has also sought to temper the change by endorsing the joint board formula for a Universal

Continued on page 36

Service Fund (USF) which will help high-cost states keep local rates lower than they would be otherwise. If that high-cost USF factor were fully employed in 1984, the flows for selected states would be like those shown in Table 4.

Avoiding bypass. The FCC's access charges order puts some of the access cost directly on customers for the first time. It has become apparent to the FCC that the subsidy built into current long distance rates provides incentives which are contrary to the public interest in maintaining a local switched network. That is, in the first instance, the subsidy due to uneconomic cost allocations stimulated competition. And now, in a telecommunications world about to have all the long distance carriers, such as AT&T, MCI, and Sprint, competing on an equal footing, the continuation of that subsidy pricing would stimulate those carriers to bypass the local switched network.

Competitors are drawn to markets where entry is relatively free, as the long distance market now is, and where profits can be expected because prices are well above economic cost. The fact that MCI made 47% return on equity in 1982, contrasted with AT&T's 12%, amply demonstrates the point. It is especially true that selective competition for high density routes has a particular impact on carriers which must provide service everywhere.

When all competitors are required to pay high, uneconomic usage sensitive access rates, those competitors will have an incentive to bypass the local switched network. The expectation is that the announced policy of gradually reducing those charges in the coming years will deter significant bypass.

> **'Competitors are drawn to markets where entry is relatively free . . .'**

Legislative proposals

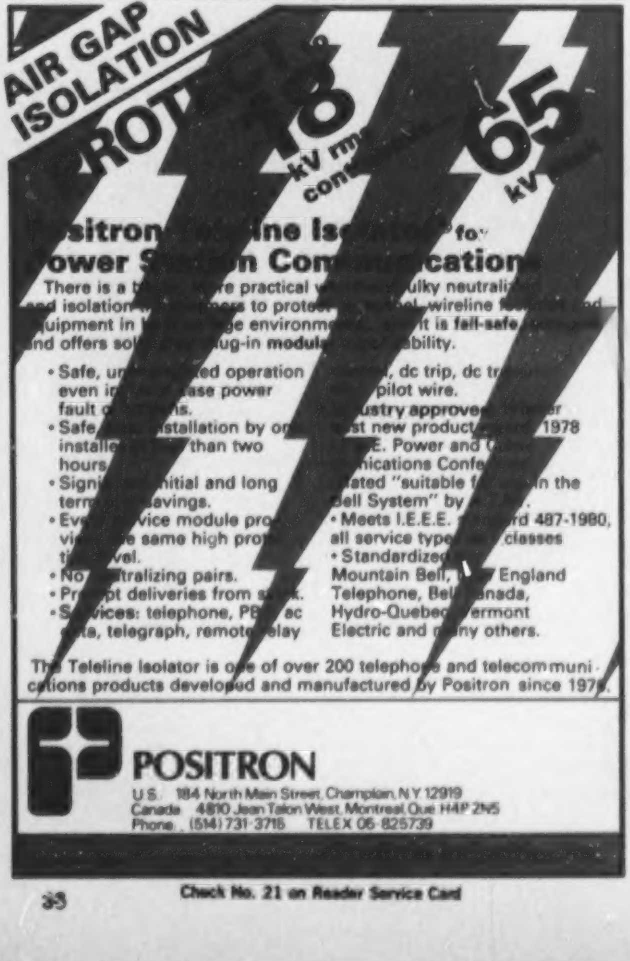
Because of concern that the flat rate and user access charges may cause a significant reduction in telephone subscribers, Congressional attention to this subject has developed. The bill proposed by Sen. Robert Packwood (R., Ore.) would have essentially doubled the continued subsidy which the joint board has established.

There are many other bills before Congress, each of which depends upon different assumptions about the very complex and rapidly changing world of telecommunications. Some of the bills are not specific enough to calculate the economic effects and permit judgments on how those proposals will benefit or handicap particular states and particular customers.

There is no doubt that the telecommunications marketplace is undergoing significant changes. It also is true that the final ramifications of these changes are not at all clear.

However, the principal stimuli to the changes are technology, competition and reduced regulatory involvement. Those forces all work to the advantage of customers in a free market system.

At this time, it is uncertain that a new form of administrative involvement—an act of Congress—will be able to better assist the adjustment of telecommunications services to market forces in the future. ☐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